CONSULTANT REPORT

CLEAN ENERGY BUSINESS FINANCING PROGRAM EVALUATION

Findings and Analysis

Prepared for: California Energy Commission

Prepared by: KEMA, Inc.

OCTOBER 2012

CEC-600-2012-007

Prepared by:

Primary Author(s):
Jon Vencil
Brendan Lucker

KEMA, Inc.
155 Grand Avenue, Suite 500
Oakland, CA 94612
www.dnvkema.com

Contract Number: 600-09-12

Prepared for:

California Energy Commission

Monica Rudman
American Reinvestment and Recovery Act Evaluation, Measurement and Verification Program Manager

Marcia Smith
Clean Energy Business Financing Program Manager

Randy Roesser
Deputy Director
Fuels and Transportation Division

Robert P. Oglesby
Executive Director

ABSTRACT

This report evaluates the implementation and outcomes of the initial phase of the Clean Energy Business Financing Program. This loan program was one of the California Energy Commission's state energy programs funded by the American Recovery and Reinvestment Act of 2009. The evaluators conducted interviews and site verifications with participants.

Evaluators interviewed three sets of market actors to assess the program's implementation: financial development corporations, state energy officers outside California, and manufacturers that received funds from the program.

The Energy Commission released the program's final funds' disbursement in early June 2012, and it has begun to receive loan repayments, based on various contract terms, from all participants. The evaluation finds that the program is achieving its goals of supporting the development of a clean energy manufacturing infrastructure in California. Manufacturing firms that participated in the program met its requirements by increasing solar technologies' manufacturing capacity, by creating jobs, and by adapting their business strategies to invest more aggressively in California rather than in other states. However, a $5 million cap on individual loans limits the amount of influence the program can have on these business decisions.

The Clean Energy Business Financing Program was successful in achieving its goals, but as it moves forward, consideration should be given to increasing the loan amount limits, strengthening its communications with participating agencies, and managing applicants' expectations about the loan process.

Keywords: California Energy Commission, clean energy, solar industry, manufacturing, financing, renewable, solar technology

Please use the following citation for this report:

Vencil, Jon, Brendan Lucker, (KEMA, Inc). 2012. *Clean Energy Business Finance Program Evaluation.* California Energy Commission. Publication number: CEC-600-2012-007.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This report evaluates the Clean Energy Business Financing Program, one of the California Energy Commission's American Recovery and Reinvestment Act of 2009-funded state energy programs. This evaluation examines the implementation and outcomes for this first-time loan program, which lasted from April 2010 through May 2012. The evaluation occurred between October 2011 and May 2012.

The program offered low-interest loans for clean energy manufacturing companies located, or planning to locate, in California. The Energy Commission used an interagency agreement with the California Business, Transportation and Housing Agency to contract with regional financial development corporations for financial underwriting and loan servicing expertise. The initial pool of funds totaled $28,999,000 as of February 2011.

This program was well-received in the market, and initially 44 companies applied for funding. Due to changing market conditions, the timing of funding distributions, and changing company strategies, the final awards went to four manufacturing firms and totaled $18.3 million (63 percent of the original pool). All awardees reported that the loans were well-structured and had attractive terms relative to alternate financing options.

The program already has begun to achieve its goals of supporting the development of a clean energy manufacturing infrastructure in California and of a viable revolving loan fund. A total of $18.1 million of program funds were disbursed to borrowers through June 2012. Through the third quarter of 2012, the Energy Commission had received nearly $4.5 million in principal and interest repayments, including the early, full repayment of one of the loans. Borrowers are current with the loan's terms. All are making interest payments, and two are repaying principal. In general, applicants emphasized a void in the market for financing clean energy companies and appreciated the availability and terms of the program. They indicated that only the cap on the amount available to borrow limited their participation.

Interviewed firms reported that the program's funding directly influenced their decision to expand or locate operations in California. As a result, the program is on track to create or retain 176–211 jobs. This represents about two-thirds of the jobs estimated in the initial eligibility applications. Total employment, from multiple shifts for example, is driven by market conditions, but the potential for these companies to employ more Californians now exists as a result of the program. In addition, solar panel production in California has increased due to the Clean Energy Business Financing Program. Once the production lines are completed, program firms will have a combined capacity to produce an additional 155 megawatts (MW) of electric generation capacity annually.

Another part of this evaluation focused on the verification of equipment purchased and installed with the loan funds. The evaluation team visited all four manufacturing sites to view the equipment and how it supported production. Expanded production capacity was evident at all sites, and newly installed equipment was clearly marked. No photos were taken due to the

proprietary nature of the production processes. Space in the production line, or a footprint, was marked with chalk to indicate where ordered equipment was yet to be delivered and installed. Once delivered, equipment such as injection molding machines or module assembly tables would replace these chalk marks.

The Clean Energy Business Financing Program is new to the Energy Commission's portfolio of programs, and the applicants did not have much experience with the detailed level of tracking or reporting required by federal government-funded loans. The federal requirements that caused the most confusion were the Davis-Bacon prevailing wage tracking and reporting processes, which requires contractors to pay their labor no less than the prevailing wage, a mechanism that prevents contractors from bypassing local labor and using lower cost labor from other areas. The reporting difficulties stemmed from the need to separate labor costs from project costs; this was especially true when labor was specialized due to the equipment's specialized functionality. All four participating companies mentioned this as a difficulty but were pleased with the assistance the Energy Commission's staff provided in interpreting and complying with the requirements.

The fact that the program is new partially explains why the financial development corporations reported poor communication with program staff after the program was launched. For example, they reported experiencing procedural changes that were inconsistent with their understanding of the program.

Solar manufacturing remains a capital-intensive process. The dollar cap on individual loans of $5 million limited the amount of influence the Clean Energy Building Financing Program could have on larger production decisions. Firms used the loans to expand production lines but not to the extent they could have. For example, one participating program firm also accepted a $100 million loan from the State of Mississippi and expanded its production capacity in that state by opening a 100 MW plant.

The program has been successful to date especially since it is a start-up operation. Successes include:

- Strengthening the clean energy manufacturing economy in California.
- Creation and retention of clean energy manufacturing jobs.
- Increasing manufacturing capacity of renewable energy products.
- Deployment of a revolving loan fund program for clean energy business development.

To improve the program as it moves forward, the program can:

- Increase the loan pool amount and limit caps to support more job creation and production expansion.
- Solidify and clarify processes for applicants and loan underwriters to help avoid misunderstandings.
- Manage expectations since government processes typically have longer process cycles than what borrowers are used to from the commercial sector.

CHAPTER 1:
Introduction

This report evaluates the Clean Energy Business Financing Program (CEBFP), a program funded by the American Recovery and Reinvestment Act of 2009 (ARRA) and administered under the Energy Commission's State Energy Programs. This loan program's initial phase lasted from April 2010 through May 2012, and from October 2011 through May 2012, evaluators studied the program's implementation and outcomes.

To assess the program, evaluators interviewed three sets of market actors. These actors included financial development corporations, state energy officers from outside California, and manufacturers that received funds from the program.

Evaluators did not design this to be a quantitative study. To understand how the funds were disbursed and if funds were used as intended by recipients, the evaluation team conducted interviews with all program participants. For the loan awardees, these interviews were conducted at the manufacturing facility where the equipment was located. The results of the interviews are consolidated and presented as common themes that emerged.

To assess outcomes, findings from the manufacturer interviews were compared to their eligibility applications. Although these are not hard thresholds by which to evaluate the program, they do provide benchmarks to compare what the program expected to achieve and what has been achieved to date.

Organization of This Report

The report is divided into four main sections. Program Overview and Methodology cover what the program is about and how the evaluation team approached the evaluation. The section discussing Interview Results is broken into three subsections: financial development corporations, other states' revolving loan fund programs, and participating manufacturer interviews. These sections summarize program operations from different perspectives. Financial development corporations and participating manufacturers are specific to this program. Other state revolving loan fund programs are included in this evaluation as an opportunity to glean operational insight from similar programs. Conclusions and Recommendations summarize the overall findings and present recommendations to help the program operate more efficiently for future iterations.

Finally, Appendix A of this evaluation includes an overview of the market for solar manufacturing to provide context for the environment in which the participating companies are operating. The analysis presented in Appendix A can also be used as a standalone report.

CHAPTER 2:
Program Overview

The CEBFP is part of California's State Energy Program (SEP), which is funded at a federal level through the ARRA. The purpose of the CEBFP is to provide up to "$30 million in low-interest loans to eligible California clean energy manufacturing businesses that create and/or retain jobs in the state."[1] The program's initial Notice of Proposed Awards in July 2010 was for $28,999,000. In February 2011, the Fourth Amended Notice of Proposed Awards for the program totaled $28,920,588. These funds were to be issued as low-interest loans for clean energy manufacturing companies located, or planning to locate, in California.[2]

The goals for this funding were to:

- Increase the manufacturing capacity of energy efficiency and renewable energy products in California.
- Create/retain clean energy manufacturing jobs in California.
- Build the infrastructure for a "clean energy manufacturing" economy.
- Generate a self-sustaining loan pool.

In addition to the below-market interest rate, a key feature of these loans, and one that differentiates them from many other sources of financing, is the fact that the Energy Commission's loans are collateralized against the equipment being purchased. This allows firms to expand their operations while maintaining their existing equity. In addition, the Energy Commission can match the amount of the loan to the value of the collateral to help reduce risk.

The Energy Commission administers the CEBFP with the assistance of the California Business, Transportation and Housing Agency (BTH). The interagency agreement partnership with BTH provides the CEBFP with expertise in financial underwriting and loan servicing experience via regional financial development corporations (FDCs).

BTH coordinates with a network of 11 FDCs throughout the state to operate the California Small Business Loan Guarantee Program. This program allows small business to obtain a term loan or line of credit when it cannot otherwise qualify for a traditional bank loan. Through BTH, four FDCs elected to participate in the CEBFP and were subcontracted to conduct underwriting and loan management functions.

All four FDCs helped implement the CEBFP. Two of these FDCs (Pacific Coast Regional and SAFE-BIDCO) have active loans. The FDCs that BTH has contracts with, along with FDCs participating in the program, are listed in Appendix A.

---

1 Work Authorization 13.

2 http://www.energy.ca.gov/contracts/PON-09-606_4th_Amended_NOPA.pdf.

The agreement between the Energy Commission and BTH calls for the participating FDCs to perform the following services for the program:

- Develop a loan guidance document that outlines the operation of the CEBFP.
- Underwrite and provide financial due diligence for each borrower.
- Develop loan documents for each borrower.
- Secure collateral for each loan.
- Coordinate monthly repayment billing.
- Review borrower requests, as required by the terms of the loan documents.
- Review borrower financial statements.
- In the event of default, handle loan collections and liquidations.

The FDCs were compensated through one-time fees related to program setup, loan documentation, and execution. In addition, the FDCs receive a fee for servicing the loans. This fee is eight-tenths of 1.0 percent annually and is based on the outstanding loan balance.

The Energy Commission is the lender, but the FDCs administer the loans. The contract for the administration of these loans was initially funded with $1,601,000 of ARRA funds. Based on a reevaluation of program operations, this was later reduced to $801,000. With the expiration of ARRA funds on April 30, 2012, the Energy Commission approved a 14-month contract extension funded with $170,000 of Energy Resources Programs Account (ERPA) Funds.

Potential loan amounts awarded through the program ranged from a minimum of $50,000 up to a maximum of $5,000,000.[3] The funds were awarded at a fixed interest rate of 2.75 percent over 5- to 7-year terms. The loans were offered to California operations that met the following criteria:

- The project must be physically located in California.
- The project must result in creating and/or retaining California jobs.
- The project must help California achieve established energy savings and renewable energy goals within the state.
- The project must be used to improve the applicant's operational energy efficiency.
- The project must be completed by March 31, 2012.[4]

In addition project funds could be applied to:[5]

- Select cost-effective energy efficiency components, systems, and technologies to promote California energy efficiency measures.

---

3 http://www.energy.ca.gov/releases/2010_releases/2010-03-17_clean_energy_business_financing.html.

4 http://www.energy.ca.gov/contracts/PON-09-606_4th_Amended_NOPA.pdf.

5 CEBFP Application Availability announcement provides details of these applications on p. 3-4.

- Select renewable energy components, systems, and technologies necessary for these renewable resources for the Renewables Portfolio Standard.
- Biomethane gas that is suitable for direct injection into the natural gas pipeline and eligible for the Renewables Portfolio Standard.

Once formally approved and the loan agreement executed, funding was made available to the applicant/borrower on a reimbursement basis. Initially 44 companies applied to participate in the program. These were assessed by Energy Commission staff using the criteria listed in the CEBFP application availability announcement. During the process, some companies either were disqualified or elected to withdraw from the process. The geographical distribution and progression of companies from application to award are presented in Figures 1, 2, and 3. A detailed look at California, national, and global solar production is presented in Appendix B.

Figure 1: Seventy-seven Firms Applied

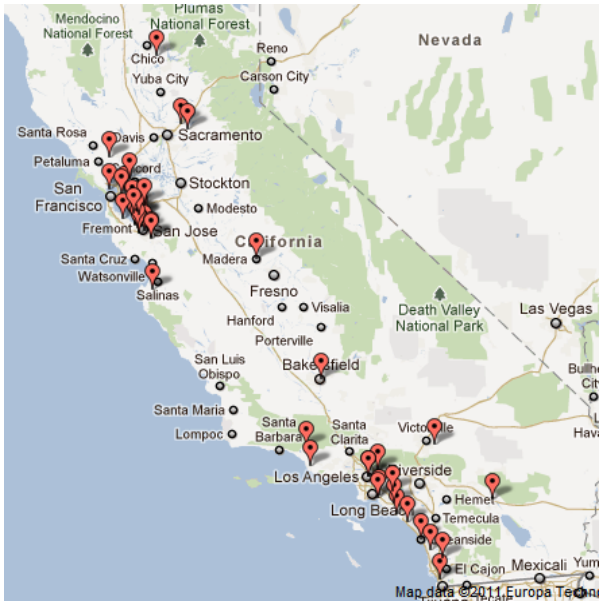


Figure 2: Twenty Firms Met Criteria

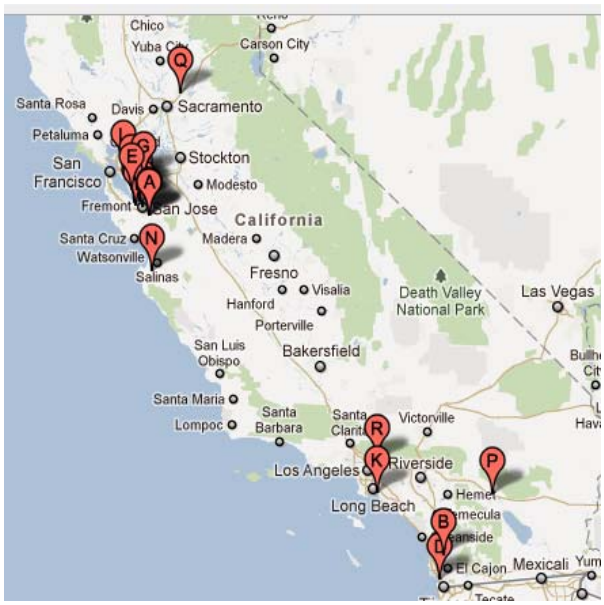
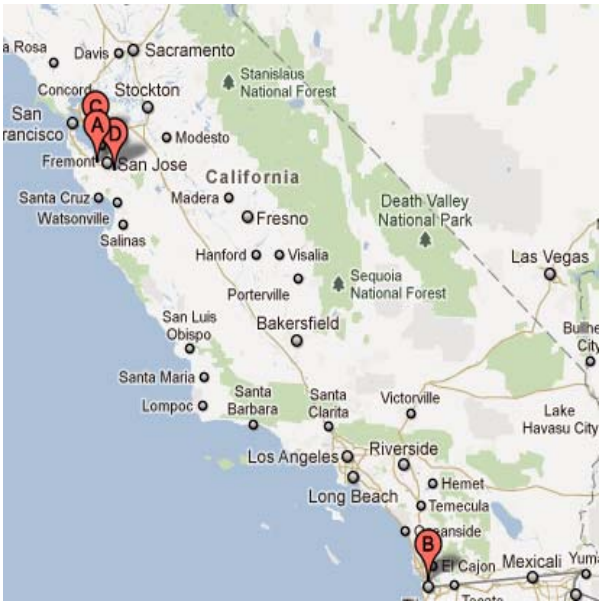


Figure 3: Four Firms Funded



Source: Energy Commission data and BatchGeo.com

Through June 2012, four loans had been awarded for a total of $18.3 million. See Table 1 for a listing of awardees and funding amounts.

Table 1: CEBFP Company Loan Agreements and Disbursements

Company	Location	Approved Agreement Amount	Final Disbursement	Percent Of Agreement Disbursed
Stion	San Jose, CA	$5,000,000	$5,000,000	100%
SoloPower	San Jose, CA	$4,997,169	$4,997,169	100%
Morgan Solar	Chula Vista, CA	$3,305,000	$ 3,153,732.39	95.4%
Solaria	Fremont, CA	$5,000,000	$ 4,955,582.32	99.1%
	TOTAL	**$18,302,169**	**$ 18,106,483.71**	**98.9%**

Source: CEBFP records

The Energy Commission disburses funds after validating invoices. This disbursement process includes receiving complete, proper documentation and pictures, and in some instances conducting site visits. Because disbursement of funds is contingent on valid and validated invoices, there is a lag between award and payments. This process takes more time but creates a strong quality control process for the tracking of awardee spending.

CHAPTER 3:
Methodology and Objectives

Evaluation Objectives

The goals for this evaluation are to (1) understand how the loans contributed to clean energy manufacturing at the state level, (2) to understand how many jobs were created as a result of the funded loans, and (3) to verify expenditures were used on capital equipment as intended.

The key objectives of this report are to document how the CEBFP has progressed toward achieving its stated goals to:

- Increase the manufacturing capacity of energy efficiency and renewable energy products in California.
- Create/retain clean energy manufacturing jobs in California.
- Build the infrastructure for a "clean" economy.
- Generate a self-sustaining loan pool.
- Affect the California workforce and clean energy manufacturing industry.
- Provide a set of conclusions and recommendations for improving the program moving forward.

In addition to these two primary goals, the evaluation team investigated how the program was implemented and how it operates. Evaluators also interviewed stakeholders from other states with similar loan programs to compare practices and identify lessons learned.

Evaluation Methods

The CEBFP was a new addition to the Energy Commission portfolio in 2010. This program was not designed for resource acquisition but as a way to transform the market for clean energy manufacturing in California. Furthermore, outcomes resulting from the program cannot be fully assessed because the CEBFP is only nearing the end of its first full cycle. As a result, the evaluation is driven by program theory and relies heavily on methods used to evaluate the delivery of the program. For example, if the program theory is reasonable and operates as designed, then the probability increases for the program outcomes to be achieved.

The program theory behind the CEBFP is that low-interest loans with favorable terms for clean energy manufacturing will induce existing California manufacturers to expand within the state. These loans will also influence out-of-state manufacturers to relocate to California. This activity will create jobs directly, but it will also support the growth of a clean energy manufacturing sector at the state level. In addition, once loans are paid back, additional loans can be offered to provide for a self-sustaining source of funds to help continue to support a California-based clean energy economy.

From an evaluation perspective the authors want to know:

- Did the program disburse the funds to applicants that met the criteria for the loan?
- Were the disbursed funds used as intended by awardees?
- Did these investments increase manufacturing capacity for clean energy in California?
- Did these investments cause or contribute to retention or creation of jobs in the California clean energy manufacturing sector?

To accomplish the program evaluation objectives outlined above, the evaluation team implemented the evaluation as stated in the evaluation plan. All documentation related to the CEBFP was collected and reviewed to develop the evaluation approach.[6] Interview guides were developed for three sets of market actors: loan underwriters, loan awardees, and program managers from other state energy offices with clean manufacturing loan programs. Other state programs were included to learn from their experiences implementing revolving loan programs.

The interviews for the loan underwriters and state energy officers were conducted over the phone. The awardee interviews were conducted on-site at their facilities and included a tour of the manufacturing areas. In three of the four cases, this location was also the corporate headquarters.

All CEBFP awardees are in the solar manufacturing industry. Even so, they operate with different technologies and target various application markets. This is a very capital-intensive industry but one that attracts attention of governments and private investors. In addition, it is driven by a variety of technologies. To set the context for the environment in which these companies and the CEBFP operate, the appendix to this evaluation includes an overview of the solar manufacturing industry from a global, national, and regional perspective.

The evaluation team achieved these objectives through a combination of primary research, interviews, and data analysis. Primary research was used to gain understanding about the progress of the program in meeting its projected goals as well as to define the CEBFP's participating companies within the larger clean tech manufacturing industry. Evaluators were able to directly evaluate the program's quantitative effects and to set benchmarks using comparable state programs through interviews with the FDCs, participating companies, and representatives from state energy offices with similar programs.

Jobs and manufacturing capability created as a result of the program were quantified through the participant surveys. This, in turn, allowed evaluators to measure the program's contribution to building a clean infrastructure. Finally, industry analysis characterized the effects and challenges indirectly affecting the program.

6 Eligibility applications were reviewed with personal applicant data omitted. Loan applications and underwriting reports were not included in this evaluation review.

CHAPTER 4:
Interview Results

Introduction

This section summarizes the results gathered from interviews with the major stakeholders associated with the CEBFP. The principal objectives of these interviews were to gather observations and assessments from applicants, borrowers, and FDC's staff for the following:

- What is the level of complexity of the program?
- What are stakeholders' perceptions concerning the benefits of the program?
- What are some lessons learned that can be implemented to help improve future iterations of the program?
- What barriers exist to funding a loan/creating a successful revolving loan?
- What steps can be taken to increase the effectiveness of the program?

Altogether evaluators conducted a total of 10 in-depth interviews with applicants, borrowers, and FDC managers involved in the CEBFP. Respondents included stakeholders with a diverse range of interaction with the program, including positions from management-, executive-, and analyst-level perspectives. These roles included:

- Planning/Design – The Energy Commission drove the planning and design of the program. FDCs had input and, in one instance, drafted a loan guidance document for the program.
- Overall Program Management – Energy Commission staff members managed the CEBFP's day-to-day operations and made policy recommendations to the Energy Commission, which had final decision authority.
- Program Administration – The Energy Commission administers the program, with financial expertise provided through the BTH network of FDCs.
- Program Tracking / Reporting – This program is funded with public dollars (ARRA) and provides an audit trail spanning the entire lifecycle of each dollar from award to repayment.
- Program Application Participation – Responsibility for accuracy and vetting throughout the application process involved all entities, but again, the Energy Commission maintained final decision authority.

Table 2 summarizes stakeholder positions and responsibilities.

Table 2: Stakeholder Positions and Interface With CEBFP

Position	Planning / Design	Overall Program Management	Program Administration	Program Tracking / Reporting	Program Application Participation
Energy Commission Staff[1]	✓	✓	✓	✓	✓
FDC Staff[2]	✓		✓	✓	✓
Loan recipients[3]				✓	✓

[1] Program staff and manager (Total consulted = 2)

[2] Executives at SAFE-BIDCO, PCR, and Valley Small Business (Total interviewed=5)

[3] Executives from each funded company (Total interviewed=4)

Source: CEBFP evaluation report, 2012

Planning/Design

In addition to the stakeholders directly linked to the program, evaluators interviewed state energy officers from three state energy programs. The objective of these interviews applied to all the interview objectives defined above, although in the context of a similar state energy loan program. The three states interviewed − Wisconsin, Michigan, and New Jersey − were asked only about their respective state's energy program and not about the CEBFP.

Financial Development Corporation Interviews

This section summarizes the results of the interviews conducted with the three participating financial development corporations. Executives from the three FDCs—State Assistance Fund for Enterprise, Business and Industrial Development Corporation (SAFE-BIDCO); Pacific Coast Regional Small Business Development Corporation; and Valley Small Business Development Corporation—participated in interviews. These interviews focused on the intended use of funds by borrowers, funding challenges, industry/market effects, and lessons learned. The findings from three interviews were combined and assessed for key themes. Four main themes emerged from the interviews and were common across FDCs:

- High market demand for loans
- Program time constraint and delay challenges
- Increased necessity for FDC and Energy Commission collaboration
- Increased communication between FDC and Energy Commission

Each of these four themes is presented in detail under Key FDC Themes.

Key FDC Themes

Common themes identified from interviews with the three CEBFP financial development corporations are summarized in the following discussion.

FDC Staff Believed That the Program Addressed a Large Demand for Clean Energy Loans

All respondents characterized the lending environment during the period of the CEBFP by (1) a lack of funding by private financing institutions and (2) high demand from companies seeking low-interest loans. All respondents felt that there were enough eligible companies to receive loans and that any future funds (for example, through repaid loans) would have ample demand. This level of interest was driven by two factors.

1) Most of the companies that applied to the CEBFP were start-ups or in the early stages of funding (early stage companies). These types of companies are not established financially, often have unproven technologies, and may not even have a well-defined market for their products. Due to these conditions, commercial banks are not willing to accept the risk of default. As a result, the main avenue for acquiring capital is through selling ownership in their companies to venture capital firms. This equity financing approach raises capital associated with typical loans but simultaneously dilutes the company value for the owners. Debt financing preserves owner equity and ties repayment streams directly to revenue stream through increased production capacity.

2) Most early-stage companies do not meet the lending criteria applied to more established companies. During the program period, commercial banks were reluctant to make loans of any type. They were rebalancing their assets by decreasing lending and paying down their own debts. This exacerbated the problem of raising capital because the tight equity positions of the banks caused companies in less well-defined (in other words, riskier) emerging industries to have even greater difficulties finding lenders. All interviewed FDCs recognized the CEBFP's ability to fill this funding void and provide debt financing for equipment to companies that had solid business plans and management teams but unproven track records.

The FDCs were comfortable recommending asset-based loans to the Energy Commission for these companies because they are experienced in the small business market and understand (like venture capitalists) that risk can be reduced by field monitoring and relating the value of the collateral to the amount of the loan. Most financial institution decisions use existing cash flow, predictive mathematical scoring equations, and restrictive lending policies.

Another benefit of this high demand for loans included low marketing costs for the FDCs. The FDCs proactively marketed the program through their existing loan outreach and marketing activities. In many cases however, companies became aware of the CEBFP on their own and approached the FDCs first.

Moving forward, the FDCs also have the advantage of relying on the Energy Commission's Web portal to offset marketing costs.

FDC Staff Experienced Challenges With Program Delays and Time Constraints Over the Course of the Program.

All three FDCs experienced challenges with program delays and time constraints. Most FDCs cited delays during the review and underwriting processes. Many of these initial delays were caused by changes to the program implemented by the Energy Commission as adjusted program operations during the program start-up phase. As a result of these delays, some companies that were recommended by the FDCs were not able, or did not want, to wait for the duration of the application approval process. In one instance, a company that received approval withdrew from the program due to delays on funding distribution.[7]

Respondents cited that, after withdrawing from the program, the companies either secured private funding or leveraged incentives offered outside California for their out-of-state operations.

In one example, these delays caused an approved company to move its operations to another state to take advantage of that state's lending programs. Two of the FDCs stated that since some companies were already in the manufacturing stage, these applicants were time-constrained by their own obligations to develop their facilities, roll out products, and create revenue. In these cases, the program delays coincided with the companies' internal time constraints and financial obligations to investors. One of the FDCs noted that most of the companies that received CEBFP loans already had a sufficient level of capital available to be able to wait for the loans to be approved and disbursed.

In addition to the delays in the application processing, one FDC noted that because these companies were in an emerging industry and were developing new technologies, to be fully analyzed the underwriting process needed more time than a traditional business loan..

In one specific example, the FDC noted that its deadline to complete the underwriting process was half the time it would have normally allotted for an equivalent private loan. Though all FDCs noted that the amount of time needed to underwrite a loan varies per company and per industry, the process for vetting emerging industry companies should provide ample time to assess the risk associated with these types of companies. One ex-venture capitalist that specialized in this type of investment pointed out, "Unlike high-tech companies, for renewable energy projects, you need to understand physics as much as finance."[8]

---

7 Delays were the result of the borrower's inability to comply with requirements tied to ARRA funds. Four other firms, Solar Power, Inc., Soliant Energy, Inc., Quantum Fuel Systems Technologies Worldwide, Inc., and Energy Innovations, Inc., received funding awards initially but withdrew from the program for reasons other than loan timing.

8 Peter Hamilton, Director of Energy Services, California Center for Sustainable Energy.

More Thoroughly Define Structure for Managing the Program

FDCs pointed out that the CEBFP's internal managerial structure at the Energy Commission was not transparent, which resulted in time delays, administrative costs, and communication burdens.

FDCs cited a need for creating a more transparent communication channel between the FDCs and the Energy Commission. One FDC had the perception that the management structure of the program within the Energy Commission was too dispersed, making it difficult for the FDCs to receive communication clearly. Two FDCs noted that from their perspective their lack of understanding of the Energy Commission's management structure exacerbated time delays as requests by the FDCs required multiple approvals at the Energy Commission level. All FDCs emphasized that the communication structure created inefficiencies and uncertainties at the FDC level. As a result, they were not able to communicate the Energy Commission's decision-making process adequately to loan applicants. The FDCs echoed each other in the need for the Energy Commission to create a well-defined managerial structure that limits the number of decision makers and presents a clear line of authority.

Increased Necessity for FDC and Energy Commission Collaboration

All of the FDCs cited the need for a more transparent and structured process for collaboration between the Energy Commission and the FDCs. Though the FDCs acknowledged their roles as fiduciaries to the loan process and not stakeholders in the final applicant selection process, the FDCs felt they could have contributed more of their expertise in selecting the applicants. They also indicated that in areas where the Energy Commission lacked knowledge of commercial lending practices, the FDC's expertise of commercial lending was not effectively leveraged.

In particular, the FDCs stated that their expertise could have been leveraged during the initial screening process prior to the underwriting analysis. Given the FDCs' relationships with their geographical business communities, leveraging FDC expertise during the initial stages of the application could have shortened delays and created a smoother process for applicants.

Interviews With States With Revolving Loan Programs

The principal objective of this section is to provide the Energy Commission with a set of standards and metrics with which it can compare the performance of the CEBFP to that of similar efforts by other state energy offices (SEO) nationwide. Many states have revolving loan programs, but only a few have programs specifically for alternative energy manufacturing. The evaluation team identified four state programs with goals similar to the CEBFP. Managers from these revolving loan programs − in Wisconsin, Michigan, and New Jersey[9]—were interviewed about the structure, benefits, and challenges of implementing a manufacturing energy loan program. In choosing which state loan programs to evaluate, evaluators prepared a list of state loan programs that met a specific set of criteria. To be included in the list, a program had to be:

9 The Ohio Department of Development was contacted for this study but did not participate for the Advanced Energy Program (non-coal).

- Designed as a revolving loan program.
- Focused on clean tech manufacturing.
- Focused on distributing loans of a similar size to the program (ranging from $500,000 to $5 million).
- Administered by a state-level agency.
- In operation for over a year, to allow for results to be analyzed.
- Designed to offer low-interest loans (below market rates).
- Created through ARRA funding (preferable, but not an absolute, criterion).

The three interviews were then combined and assessed for common themes. Each of these three themes are identified and analyzed in Key State Energy Office Themes.

Key State Energy Office Themes

Common themes among the different manufacturing loan programs that were identified during the State Energy Office interviews are summarized in this section.

State Energy Programs Targeted an Industry That Was Struggling as a Result of the Economic Crisis

All state program managers acknowledged that energy loans focused on "retooling" industry-benefitted manufacturers. Manufacturers in the states interviewed had been in particular need of a low-interest loan program due to the changes in private lending that were a result of the economic crisis that started in 2007. The energy loans provided the states an opportunity to fill a lending void caused by the tight equity position of the private banking sector from 2008 and continuing into 2012. By providing low-interest lending, the state programs were able to indirectly create jobs when the states' traditional manufacturing leaders were unable to invest in employment. In Michigan, for example, the program was used to counterbalance the loss of economic stability provided by the state's traditional auto industry. In summary, all the programs confirmed that there was sufficient demand from the clean energy manufacturing sector for these loans.

All State Energy Programs Administered the Loan Evaluation and Underwriting Process In-House

All three state programs were consistent in administering the loan screening and underwriting process in-house. In each of the states, the agency responsible for administering the loan program either partnered with an economic development/commerce agency to manage the loan or leveraged internal underwriting expertise to evaluate applicants. For example, Wisconsin's revolving loan managers relied on the Wisconsin Department of Commerce to administer the loans. Wisconsin's Department of Commerce has a history of underwriting loans and familiarity with existing in-house business assistance programs. While all the programs examined were conducted in-house, one state acknowledged that for the creation of a loan loss reserve program it was considering using a third-party entity to administer the loans. The reasoning for its use of a third-party entity was due to its lack of expertise in that area. The agencies with lending experience in each state are the:

- Wisconsin Department of Commerce/ Wisconsin Economic Development Corporation.
- Michigan Economic Development Corporation.
- New Jersey Economic Development Authority.

Due to the existing lending experience of these agencies, the process for underwriting and screening applications was streamlined and consistent. In addition, these agencies had working relationships with the business communities applying for loans and were able to use these relationships to accelerate the process of identifying and screening applicants.

States Already Had Working Relationships With Economic Development Agencies

The states contacted for this study were either part of, or had established working relationships with, their state's economic development offices. Having this direct contact with the states' manufacturing base allowed the loan programs to identify and qualify candidates relatively quickly. As a result, these programs spent very little of their budget on marketing and outreach.

States Did Not Track Jobs Retained/Created Directly.

There was self-reporting by loan recipients on jobs, but in most cases reported job estimates were based on guidelines set by the U.S. Department of Energy (DOE) for ARRA-funded programs where $92,000 in spending is equal to one job created.

Distributed Funds Within in Year One of the Program and Had Begun Collecting Interest Payments by Year Two

All three state energy loan programs completed their first round of financing within one year of application solicitation due to established and streamlined loan origination and servicing processes. The following matrix shows the amount of money originally loaned and the expected money available for a second round of funding for each program. As shown, the state of Wisconsin was able to distribute the most funding in its first round. For the two states with revolving loan programs, accrued interest payments from the first round allowed each state to distribute more than $1 million for a second round by early 2012. The three states were successful in distributing funds in the first year of program operation.

Table 3: Comparison of State Energy Loan Program Funding Rounds

State Energy Revolving Loan Funding 2010-2011				
Programs	Clean Energy Business Loan	Clean Energy Advanced Manufacturing	Edison Innovation Clean Energy Manufacturing Fund	Clean Energy Business Finance
Partner agency	Economic Development Corporation	NA	Economic Development Authority	Business, Transportation and Housing
Loan Amount (Max)	No min or max	2,500,000	500,000	5,000,000
Matching Funds Required	Yes	No	Yes	Yes
Round 1 funding pool / distributed	$55 million / $55 million	$17 million / $17 million	NA	$18.3 million / $18.1 million
Number of Round 1 awards	30	26	NA	4
Round 2 expected funding pool	$1 million *(2011)*	$1.5 million *(2012)*	NA	$10.0 million[10] *(2014)*

Source: CEBFP evaluation report, 2012, recovery.gov, state loan program websites

Manufacturer Interviews

The four manufacturing firms that were awarded loans through the CEBFP were interviewed at their facilities as part of this evaluation. Each was involved in manufacturing final products for the solar industry. For more detail on the companies, their technologies, and their place in the broader industry, see Appendix A: Solar Manufacturing Industry Overview.

Key Manufacturer Themes

Common themes among the CEBFP manufacturing firms identified during the interviews are summarized here.

Companies Expressed the Maximum Limit on the Loan Was Too Low

Manufacturing is a capital-intensive process. Clean energy is no different. Having access to the loan pool is valuable, but most companies are looking for funding in the range of hundreds of millions of dollars. The $5 million cap limits loan exposure but also may limit any substantive influence on company decision making or behavior.

Companies Felt Having a Loan From a State or Federal Agency Was a Positive Attribute

These early-stage funding companies are constantly searching for capital to finance operations and/or equipment. The CEBFP funds only equipment purchases, but having a loan (or loan

10 Estimated by Energy Commission staff.

guarantee) from a recognized government agency adds credibility because it implies the company has already gone through a vetting process and has the ability to pay back a loan.

Companies Appreciated That the CEBFP Application Process Was Concise

Firms noted that the paperwork was not overly burdensome compared to other similar state or federal programs. They also appreciated the relatively fast (about two weeks) reimbursement of invoices that are approved by the Energy Commission but paid directly by the State Controller's Office.

Firms Expect This to Be a Revolving Loan Fund

Firms had the expectation that the CEBFP would be a revolving loan fund with potential to participate again in the future. This factored into their decision to participate in the program initially. Firms saw the required staffing and learning as part of their investment in being able to raise funds.

Firms Were Confused by the Davis-Bacon Act Requirements

All companies expressed confusion over the prevailing wage component of the program. Even with the Davis-Bacon information that was included in the CEBFP's application/solicitation package, firms did not fully understand how to interpret or complete the prevailing wage calculations for their projects. In some cases, this led to forfeiting reimbursement on particular equipment. In another case, the vendor's bid had to be increased, driving up the effective interest rate of the loan from the company's perspective. (In other words, the solar firm loan stayed the same, but it had less working capital than planned.)

Asian Manufacturers Are a Big Source of Competitive Pressure

All companies emphasized the influence of China, South Korea, and Taiwan when talking about the industry. Solar manufacturers in China are heavily subsidized by their government, and this presents a competitive threat to U.S. solar manufacturers. Whether these subsidies are illegal is being investigated by the U.S. Department of Commerce. Foreign subsidies and possible product dumping have become greater issues as Asian panels have increased to equal American quality (for example, 25-year warranties) while simultaneously dropping in price.

Manufacturer Interview Details

More detailed findings from the in-depth interviews with manufacturer are presented in this section.

Clean Energy Business Finance Program

Although all of these companies can be considered start-ups, each was in a very different position regarding its financing needs. Some had gone through several rounds of funding with venture capital, had secured loan guarantees from the U.S. DOE, or were in the initial stages of raising money. Manufacturing is a capital-intensive industry, and even for the more established companies, immediate access to capital (whether for operations or equipment) trumped low-interest rates. In one case, a company made the point that if it cannot have access to a low-interest loan for a year or more, it will have to take out a short-term, high-interest loan to keep

afloat until it has access to the low-interest loan. This "bridge-funding" approach is not feasible for many companies. Increasing their debt load for operations reduces their ability to use capital for equipment investments and restricts cash flow when they do have revenue.

All awardees felt the loans were structured well and had attractive terms. In addition, these loans were considered better than loans offered directly by the U.S. DOE because they were less restrictive in their use. Firms valued the fact that a loan was collateralized against the equipment being purchased and its low-interest rate, but the most attractive part of the loan was how fast it could be distributed compared to U.S. DOE loans.

All firms acknowledged investigating funding options through state programs outside California. Other states offered more comprehensive incentive packages than California did. These packages proposed by states such as Mississippi, Arizona, and Oregon included larger loan amounts, immediate sales tax breaks, and longer-term property tax relief. These states offered loans in the $100 million range, multiyear sales and property tax breaks, and workforce training. Even though these state incentive packages were more comprehensive, they were attractive to companies in start-up mode primarily because of the large amounts of up-front funding – not longer-term tax relief. The types of companies that participate in the CEBFP are companies that need short-term debt or equity financing options. Long-term tax credits or workforce training programs are geared toward more established firms or firms in established industries. Tax credits are not as valuable to firms looking to stabilize cash flow.

Attractive Parts of CEBFP Loan According to Manufacturing Firms

Manufacturing firms found CEBFP loans attractive for:

- Their limited level-of-use restrictions imposed by Energy Commission
- A collateralized component, which allowed them to tie CEBFP loans to new equipment purchases rather than existing capital

Firms reported they were extremely satisfied with the communication between the Energy Commission and their companies. All noted that the Energy Commission pushed their requests through quickly and efficiently. They were able to get their funding and get over the hurdles swiftly, which is extremely necessary for growing companies that need capital. In the same vein, firms also expressed that at times communication was inconsistent with their FDC contacts. It was unclear to firms if on occasion their FDC contacts were withholding information or if they genuinely did not know the status of loans. Either way, this encouraged firms to try and work with the Energy Commission directly.

Use of Funds

Even though companies found the CEBFP loan terms attractive, these funds represent only a fraction of their funding needs. As stated earlier in the report, solar equipment manufacturing is highly capital-intensive, and these start-up firms actively search out federal, state, and city loans and grants, as well as private debt and equity financing. Financing levels compared to CEBFP loans are shown in Table 4. This also illustrates the theme that emerged with regard to loan size.

Table 4: CEBFP Funding Relative to Total Funding ($ millions)

Company	Other Sources	CEBFP Agreement Amount	Total Raised	CEBFP As % Of Total
Stion	$245	$5	$250	2%
SoloPower	$359	$5	$364	1%
Morgan Solar	$29	$3	$32	10%
Solaria	$297	$5	$300	1%

Source: Interviews and Dow Jones VentureWire

In all cases the funds are being used to purchase the equipment described in the program application forms. The majority of equipment purchases are being used to ramp up production of primary products. This equipment is also being used to support manufacturing process improvement. The types of equipment include injection molding machines and customized equipment for assembly lines, testing, and diagnostics. All of these verified purchases support the claim that, to date, the CEBFP has achieved its main objective of providing loans for equipment only and that funds were not diverted to impermissible uses.

The process for acquiring equipment was not without problems, however. The need to report labor costs, as federally required through the Davis-Bacon Act, created inefficiencies in the use of funds and was a source of frustration for borrowers. Even though all Davis-Bacon requirements for prevailing wage information was covered in kick-off meetings with borrowers, as well as loan application materials, initially there was a consistent lack of understanding by borrowers about details of the Davis-Bacon Act's prevailing wage calculation and reporting requirements. This is especially true since the federal government's definition of prevailing wages does not necessarily coincide with regional market wages.

In a few cases, this created situations when funds were not applied to specific equipment listed in the original applications. In these cases, the Energy Commisision reallocated CEBFP funds to subsequent similar equipment purchases, and installation labor was bid and tracked to enable reporting and verification. In one instance, a borrower reported paying labor costs that were 30 percent higher than the vendor bid just to comply with the loan's terms. In all cases, however, borrowers emphasized that assistance from Energy Commission staff helped them understand the wage reporting requirements better so they could avoid future problems.

Effect on Employment and Location

Interviewed firms reported that funding through the CEBFP directly influenced their business decisions about California operations. One firm was preparing to locate its production to Mexico where a facility already existed. Another was preparing to relocate full operations to Oregon, while another was considering Mississippi. These firms developed alternate business strategies that included California operations contingent on program funding. This includes, for example, low-volume production lines that can also be used for production process research and development in addition to lines that can be devoted to specialized products.

Firms all reported that the use of the CEBFP funds retained or created jobs in their California facilities. Salaries varied across firms due to the types of jobs created. Full-time positions ranged from administrative staff to operators and maintenance technicians to specialized engineers. Wages for production staff were similar across companies and geography. Table 3 lists the labor information provided by manufacturers.

During the evaluation time frame, some program participant companies were having their production lines certified, so actual job numbers were not available. The precise number of jobs created will not be known until all funds are distributed and lines are operational. As a result, estimates are shown as ranges and represent the maximum direct effect attributable to the CEBFP's funding. According to these self-reported estimates, the number of jobs created or retained in California directly attributable to the program will be between 176 and 211. CEBFP applications for funding estimated creating 322 full-time jobs.

Table 5: Employment and Wages (estimates at full production capacity)

	Titles	Jobs From Application	Jobs From Interviews	Hourly Wages	Type	Full Benefits
Stion	Operators / techs	89	10–20	$13–$20	agency full time	No
SoloPower	Operators / techs	50	80	$18– $35	payroll full time	Yes
Morgan Solar	Operators / techs	83	20–35	$12– $30	payroll full time	Yes
Morgan Solar	Engineers / managers	21	6	$40– $50	payroll full time	Yes
Solaria	Operators / techs / admin	79	60–70	$12–$15	agency full time	No
Totals	**—**	**322**	**176–211**		**—**	**—**

Source: CEBFP evaluation report, 2012

These jobs ranged from local unskilled production assembly workers contracted through staffing agencies to experienced high-level manufacturing engineers internally reassigned or recruited from other firms.

The interviews were conducted nearly a year after the applications were completed, and production was ramping up as funding was distributed. During the interviews, firms estimated the number of jobs resulting from the investment of program funds between 176 and 211 full-time jobs. If the higher estimates are realized, the program will have created 66 percent of the jobs originally envisioned. Because production lines are not fully developed, these estimates remain uncertain and will change as production lines are built out and market conditions fluctuate. The CEBFP's funding helped lay the foundation for expanded production lines. Market conditions, however, will dictate the usage rates for these lines.

Evaluators emphasize that 176 jobs created with $16.1 million in funding equates to $91,308 spent per job created/retained. This value compares favorably with the U.S. DOE's formula estimate for ARRA funds of $92,000 spent per job created/retained.

Production Capacity

The funding provided by the program helped generate additional manufacturing capacity for California's manufacturers. The size of the loans, however, limited their effect on overall production. In three of the four cases, these loans are being used primarily to finance lower production lines used for research, development, and process improvements. Large-scale production is being established in other states with larger loan amounts, lower operating costs, and more comprehensive incentive packages. These states include Oregon and Mississippi. Production capacity of CEBFP firms is presented in Table 6. More details on California's, national, and global production capacity are provided in Appendix B.

Table 6: Company Full Production Capacity (MW)

Company	In state	Out of state
Stion	100	100
SoloPower	20	400
Morgan Solar	10	NA
Solaria	25	25
Total	**155**	**525**

Source: interviews and press releases

Industry/Market Impacts

All companies consider Chinese/Asian producers as the competition to beat. All companies cited that the Chinese government's large subsidies in solar were at such a larger level than those provided in the United States that China is making it difficult for them to compete. None of the companies interviewed, however, attributed that to unfair trade practices. They expressed a desire for the federal government to step up support of the clean energy industry with more funding opportunities and program options.

Companies also expressed their belief that the winning firms over the next three to five years would be the ones that can compete on price. Production techniques and technology efficiency (as opposed to new technologies) will be the industry's focus during this period. As one executive characterized it, the key to success in the current market climate is "faster, cheaper, better." A more detailed overview of the industry is provided in Appendix A.

CHAPTER 5:
Conclusions and Recommendations

Conclusion

Based on the interviews with the CEBFP's participants, the program achieved its goal of funding clean energy manufacturing firms that retained or created jobs in California. Seventy-seven firms with a broad base of technologies applied for loans. These technologies included solar, biofuels, wind, fuel cells, batteries, and water efficiency. The Energy Commission awarded CEBFP loan funds to 10 solar companies, 7 accepted the terms and loans were executed, and 4 remain in the program, drawing down their loan funds. The original pool of funds was $28.999 million. The final awards totaled $18.3 million, of which 98.9 percent were disbursed.

Jobs Retained/Created

Based on the company interviews and site visits, evaluators estimate the program will have directly retained or created between 176 and 211 full-time jobs. Most of these (80 percent) are production-level jobs with hourly wages from $12 to $35 per hour. The remaining jobs (20 percent) represent maintenance technicians, engineering managers, and administrative staff. These salaries will range from $65,000 to $100,000 per year.

Participant Satisfaction

Overall the program worked well for applicants, and they attributed most of this to the attention they received from Energy Commission program staff. Firms with U.S. DOE loans appreciated the limited restrictions on the CEBFP funds and that the funding cycle (though longer than other sources) was shorter than the U.S. DOE. They felt that the loan application process was straightforward even though there were delays at times that could not be explained. In addition, once funds were disbursed, the invoicing process was confusing due to a lack of understanding about prevailing wage tracking and reporting.

Participating FDCs had a different perspective on the program. They have many years experience with small business loans but reported that their expertise was unduly discounted during the underwriting process. They expressed concern over not being brought in for their expertise and then not being more included in decision-making. For example, there was confusion by the FDCs over whether they would be able to collect and process the loan payments on behalf of the Energy Commission for the loans that they underwrote. Since the fees collected from this activity were factored into their decision to participate in the program, not having a consistent message added another level of dissatisfaction with the CEBFP's implementation.

Recommendations

At the end of its first full cycle of operation, the program has disbursed all loan funds and has begun to receive loan repayments based on the terms of the loans. It has begun to achieve its goals of supporting the development of a clean energy manufacturing infrastructure in California. Manufacturing firms that elected to participate adapted their business strategies due to the program. The lower dollar cap on individual loans however limits the amount of influence the program can have.

Evaluators generated recommendations from the themes that emerged from the interviews. They are not intended to be purely prescriptive actions but should be considered in the context of any program design changes going forward.

Either Eliminate FDCs From the Loan Process or Have Them Bear More Risk/Reward for Outcomes

The FDCs did not have a stake in to whom the Energy Commission loaned funds because FDCs do not fund the loans. There is an incentive for FDCs to be in the program because it expands their client base and allows them to get more experience with emerging technology markets (in addition to a participation fee). Yet the FDCs lose nothing if loans become nonperforming. If lenders have greater exposure to the outcomes, the resulting loan portfolio or the types of lenders that participate in the program may be significantly different.

Continue to Use the Energy Commission's Website as an Advertising Source for Program

Companies continue to express strong interest in government-sponsored loans. The companies the evaluation team interviewed noted that they continuously scan for programs and are informed by existing funders. Creating a strong website portal for the revolving loan will contribute to both advertising the program and maintaining an updated source of information for the program's continuing status.

Get Funding out the Door Faster

The CEBFP was able to disburse funds much faster than the U.S. DOE but still lags behind other states in the time it takes to award and disburse funds. Streamlining the decision process for applications and underwriting will benefit the program by providing underwriters with more defined decision criteria and will help reduce the amount of assumed risk inherent in the emerging technology industries that the CEBFP targets. Evaluators make this recommendation with the understanding that all loan awards, loans, and modifications to loan terms have to be approved by the Energy Commission at a monthly business meeting and require a public notice process.

Work With Underwriters/Servicers Prior to Creating Loan Process Deadlines to Ensure Better Collaboration Within the Program

Include financing experts during the initial loan applicant screening process to address the Energy Commission's lack of underwriting knowledge. The interviewed FDCs expressed the

opinion that more financial expertise at the process's beginning would have avoided decision delays later on.

Provide More Funding or Higher Caps to Address the High Demand for These Types of Loans

Moving forward, it is important to implement a strong structure for a revolving loan so that funding can be sustainable. Although it would be great continuing to finance these revolving loans at a federal level, creating a revolving loan with the funds instead allows states to independently continue to finance these programs when federal funds are no longer available.

Continue the CEBFP as a Revolving Loan Pool

All four firms expect the CEBFP to be a revolving loan fund. They treated their decision to participate as an investment decision. They expect the time and effort invested in learning about the process and the contracting requirements to be a competitive advantage in the next round of funding.

APPENDIX A
Financial Development Corporations

Financial Development Corporation	CEBFP participating firm	Active CEBFP loans
California Capital Financial Development Corporation Clarence Williams, President 2000 O Street, Suite 250 Sacramento, CA 95811 Voice: 916-442-1729 Fax: 916-442-7852 E-mail: cwilliams@cacapital.org	**NO**	**NO**
Nor-Cal Financial Development Corporation Elza Minor, President 2213 Harbor Bay Parkway Alameda, CA 94502 Voice: 510-522-6661 Fax: 510-522-6658 E-mail: em1nor@yahoo.com	**NO**	**NO**
Valley Small Business Development Corporation Debbie Raven, President/CEO 7035 North Fruit Avenue Fresno, CA 93711 Voice: 559-438-9680 Fax: 559-438-9690 E-mail: draven@vsbdc.com	**YES**	**NO**
California Coastal Rural Development Corporation Karl Zalazowski, President 221 Main Street, Suite 301 Salinas, CA 93901 Voice: 831-424-1099 Fax: 831-424-1094 E-mail: karl_zalazowski@calcoastal.org	**NO**	**NO**
Inland Empire Small Business Financial Development Corporation Robert M. Saenz, President 516 North Lemon Avenue Ontario, CA 91764 Voice: 909-391-6787 Fax: 909-391-6765 E-mail: rsaenz@iefdc.org	**NO**	**NO**
Small Business Financial Development Corporation of Orange County Michael Ocasio, President 1913 East Seventeenth Street, Suite 210 Santa Ana, CA 92705 Phone: 714-571-1900 Fax: 714-571-1905 E-mail: mocasio@sbfdoc.com	**NO**	**NO**

Financial Development Corporation	CEBFP participating firm	Active CEBFP loans
Hancock Small Business Financial Development Corporation Edward H. Lee, President 4022 West Olympic Boulevard Los Angeles, CA 90019 Voice: 213-382-4300 Fax: 213-382-4732 E-mail: edwardlee@hsbfdc.org	**NO**	**NO**
Pacific Coast Regional Small Business Development Corporation Mark J. Robertson, Sr., President 3255 Wilshire Boulevard, Suite 1501 Los Angeles, CA 90010 Voice: 213-739-2999, Ext. 222 Fax: 213-739-0639 E-mail: mark_robertson@pcrcorp.org	**YES**	**YES**
San Fernando Valley Small Business Financial Development Corporation Roberto Barragan, President 5121 Van Nuys Boulevard, Third Floor Van Nuys, CA 91403 Voice: 818-205-1770 Fax: 818-205-1785 E-mail: roberto@vedc.org	**YES**	**NO**
California Southern Small Business Development Corporation Michael McCraw, President 600 - B Street, Suite 2450 San Diego, CA 92101 Voice: 619-232-7771 Fax: 619-232-6743 E-mail: mmccraw@casouth.com	**NO**	**NO**
State Assistance Fund for Enterprise-Business and Industrial Development Corporation (SAFE-BIDCO) Mary Jo Dutra, President 1377 Corporate Center Parkway, Suite A Santa Rosa, CA 95407 Voice: 707-577-8621 or 1-800-273-8637 Fax: 707-577-7348 E-mail: mjd@safe-bidco.com	**YES**	**YES**

APPENDIX B
Solar Manufacturing Industry Analysis

TABLE OF CONTENTS

TABLE OF FIGURES

Solar Technologies Analysis

The evaluation of the Clean Energy Business Financing Program (CEBFP) would not be complete without documenting the context in which the program and the selected companies operate. This report provides context with a broader analysis of the current solar industry along with the implications for both the firms and the program's risk exposure. The overall success of these companies, and the program, is based on both current and future market conditions.

Given the four recipients of CEBFP loans are solar manufacturers, evaluators conducted a market analysis of the solar industry to highlight some of the market challenges and trends that could affect these companies. This report analyzes the solar market as it applies to the different types of solar technologies produced by CEBFP firms. Within each of the technology sections, a subsection is provided to highlight the implications of the technology's trends on the CEBFP companies.

Solar Technologies Overview

This section provides an overview of the solar industry's different technologies followed by an in-depth analysis of each of the photovoltaic technologies manufactured by the CEBFP participants and applicants.

Converting sunlight into electricity to create solar energy is typically derived from two types of technologies: solar photovoltaic (PV) and concentrated solar power (CSP). CSP systems indirectly create electricity using mirrors or lenses to heat fluid, which then drives a steam turbine generator through a liquid-to-steam heat transfer. Using a separate method, PV directly generates electricity from solar radiation through using semiconductor cells.

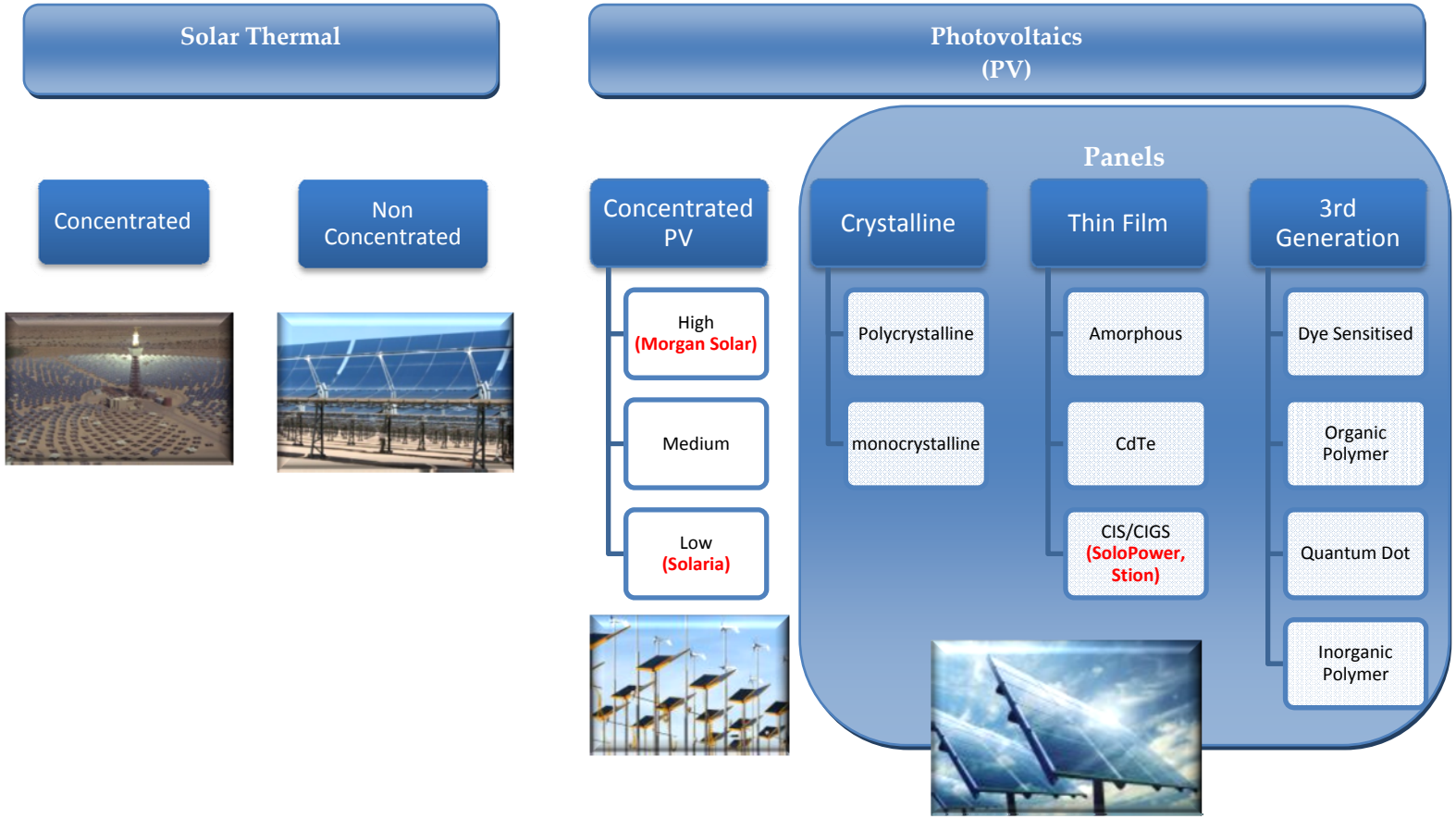
Within PV there are several different technologies, differentiated by the photovoltaic material each uses as a semiconductor. The main types of PV semiconductor materials include crystalline silicon (c-Si), cadmium telluride (CdTe), copper indium gallium selenide (CIGS), and amorphous silicon (a-Si). Crystalline silicon is the most prevalent and traditional branch of PV technology. As shown in Figure 4, c-Si can be manufactured using two types of silicon cells, monocrystalline or polycrystalline.[11] In the second most prevalent branch of PV technology, thin film panels use small amounts of CdTe, CIGS, or a-Si as semiconductor materials to create a panel. The third branch of PV technology consists of technologies such as dye-sensitized cell technology and organic polymer cell technology, which remain largely in the research phase and are extremely limited in the market. Finally, a specialized form of PV is represented by the branch of concentrated PV (CPV) technologies, in which a solar cell—either silicon or thin film—receives concentrated sunlight from a set of optical components. This magnification of the sun enhances module efficiency to varying degrees, ranging from high-concentration PV panels (HCPV) to low-concentration PV panels (LCPV).

Figure 4 shows the two types of PV technologies, concentrated photovoltaics (CPV) and thin-film PV technology, that CEBFP participants manufacture.

---

11 PV cells made from single silicon crystals are known as *monocrystalline silicon cells,* and PV cells made from multiple silicon crystals are known as *polycrystalline silicon cells.*

Figure 1- Solar Technology Types, (CEBFP participants in red)



Source: KEMA, 2012

Photovoltaic Technologies

This subsection provides a high-level analysis of the three types of PV technologies manufactured by the CEBFP participants and applicants: thin film, crystalline silicon, and concentrated PV.

Thin-Film Technology

First experimented with at the University of Delaware in 1980, thin-film solar modules are developed by layering thin strips of PV material on a substrate.[12] [13] The three most popular materials used for thin film technology include cadmium telluride (CdTe), copper indium gallium selenide (CIS or CIGS), and amorphous silicon (a-Si).

In 2010, thin-film technology accounted for an estimated 13 percent[14] of the global market at the cell production level, as shown in Figure 5[15], and 17 percent of the global market at a module level.[16] With overall production levels of 3,627 megawatts in 2010, some forecasts predict the thin film market could reach 15,895 MW by 2020, representing a CAGR of 16 percent over the period 2010-2020.[17] Of the three main thin-film technologies, CdTe and a-Si currently represent 80 percent of thin-film production while CIGS represents the remaining 20 percent. While projected growth for thin film production is high, growth will likely be stagnant as long as low silicon prices keep c-Si panel costs low, global solar market supply outweighs demand, and solar subsidies continue to be cut across the global market. Moving forward, these competitive prices will likely lead to consolidation of the overall industry into fewer, high-producing, and efficiency-maximizing firms. thin-film companies that can scale up quickly, produce high-efficiency products, and adapt to decreasing manufacturing costs could secure positions as major players in the market.

12 See section A.2 for a more in depth description of how thin-film modules are created.

13 U.S. Department of Energy, 2009.

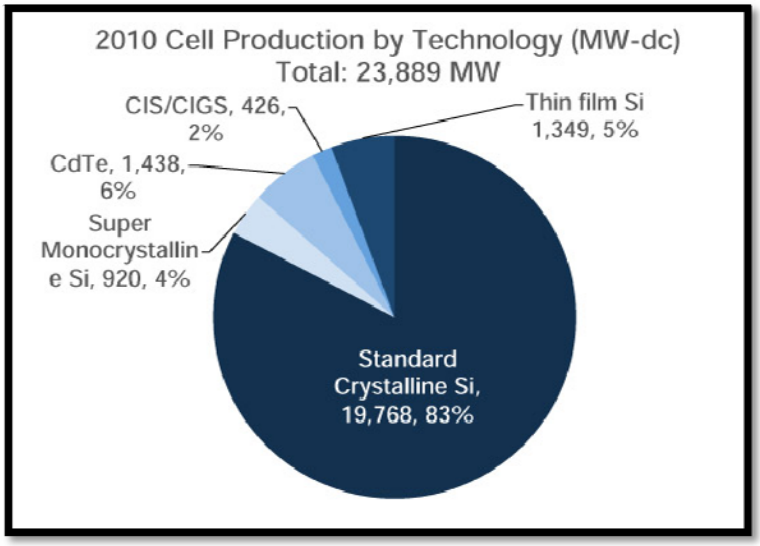
14 Greentech Solar, 2011.

15 This includes CdTe, CIGS, and thin-film Si.

16 MarketResearch.com, 2012.

17 *Ibid.*

Figure 2: Cell Production by Technology (MW-dc), 2010



Source: Greentech Media

Even though thin-film technologies typically have two-thirds the efficiency levels of c-Si cells due to having less materials, CIGS and CdTe gained price advantages in the early 2000s due in part to their ability to avoid using silicon. During the mid-2000s investment in the technology began to increase as silicon prices continued to rise. In the last couple of years, prices for silicon plummeted, in part due to lower global demand for solar PV.[18] These current decreasing silicon costs clearly present a challenge to technologies such as thin–film, which have carved out a section of the market for silicon alternative technology. If prices for silicon remain low in the short term, thin film companies will have to find ways to lower costs to compete with silicon-based manufacturers.

CEBFP Implications

The market for thin-film companies is characterized by both internal and external competition. Within a thin-film market that still lacks standardization, companies are competing to develop unique products to differentiate themselves from other thin-film manufacturers. Outside the thin film market, c-Si technology continually dictates the cost and efficiency benchmark levels for the industry as a whole. In the near term, CEBFP companies will witness thin-film production continue on an upward growth path that becomes more consolidated at a market level. Both of the CEBFP companies manufacturing thin films have developed technologies that are unique and target niche applications. For them to survive the consolidation and take advantage of the long-term growth in the market, their products must continue to adapt to a low-cost market while maintaining their unique edge in the technology.

Crystalline Silicon Technology

Within the PV market, crystalline silicon has traditionally been the dominant photovoltaic semiconductor material used, with monocrystalline silicon cell technology representing the

18 Silicon prices and their effects on the solar industry are documented in Section A.5.4.

largest technology segment in the industry. The success of the technology is in part due to its cell efficiency levels—averaging 15-20 percent − which are some of the highest in the solar market. Prices for panels are measured in terms of watt peak (Wp).[19] Within the silicon-based market the lowest module prices in the United States and Europe range from $1.08/Wp to $1.2/Wp, which are 30 to 40 cents higher than the lowest thin-film module prices.[20]

On a global level, the c-Si manufacturing market has grown significantly in China and is expected to increase its presence in that region moving forward. In 2010, China produced 54 percent of global c-Si modules and 47 percent%of global c-Si cells.[21] This large market share is attributed to China's ability to provide low-cost solar panels, which is driven by access to large amounts of private and public capital, second-mover advantages[22], and cheap labor.[23] Of these contributing factors, access to capital has been crucial in developing market-ready solar technologies.[24]

While China's government has been providing large sums of capital to scale up solar firms in the country, U.S. c-Si firms have been trying to compete by staying at the forefront of industry innovation. As shown in Figure 6, the United States leads the world in venture capital and private equity funding, while its investments in solar manufacturing facilities are dwarfed by other comparable economic regions.[25] The outcome of this situation is that U.S. start-ups are watching their competitors in China and Europe scale up manufacturing facilities with market-ready solar technologies, gaining larger market shares and faster economies of scale. While other countries are focusing on funding manufacturing facilities, the large concentration of U.S.-based VC funding is creating an environment of start-up solar companies that focus on niche markets or introduce innovative technologies.

---

[19] Watt Peak refers to a solar module's output as measured under an industry-standardized light test conducted at the product manufacturer's facility. Given that the degree of sunlight intensity varies throughout the day and based on weather conditions, this represents the maximum output a solar module can produce in optimal conditions.

20 SolarBuzz, 2012.

21European Photovoltaic Industry Association, 2010.

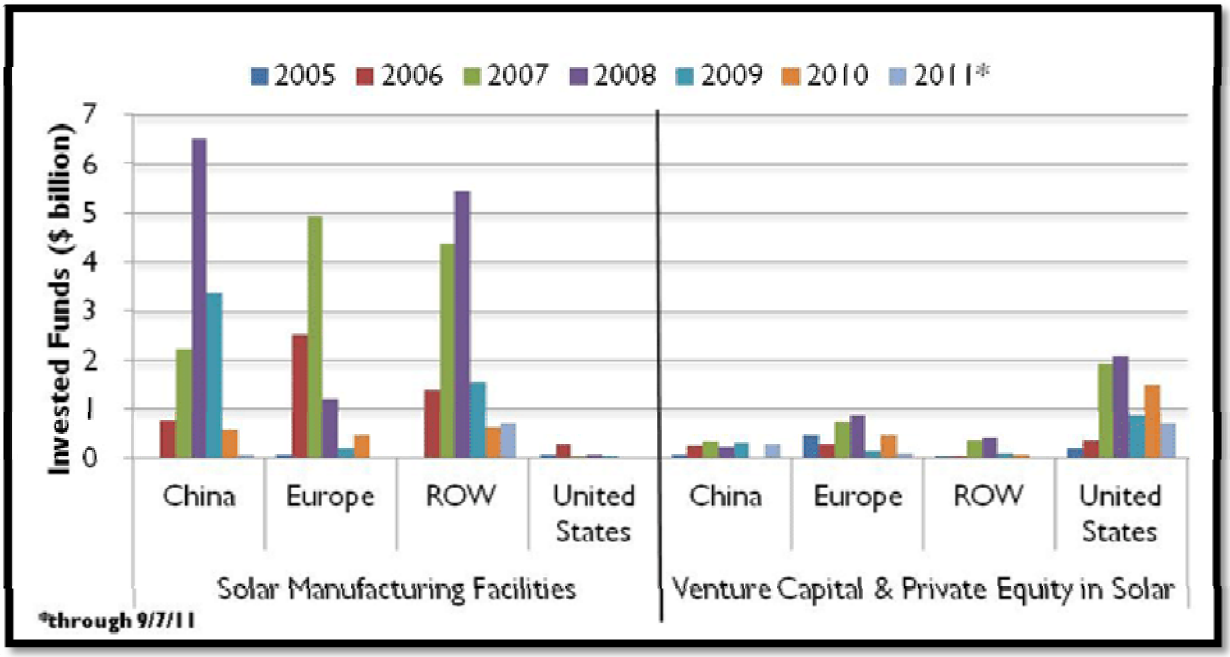
22 According to the Cambridge University Press, a Second-mover advantage is when a company offers a product at a later time than a competitor, because it can learn from customers' reactions and offer something better than its competitor.

23 A more detailed account of Chinese market advantages is described in the *Chinese Manufacturing Growth* section.

24 Access to capital for Chinese firms is discussed in more detail in the *Chinese Manufacturing Growth* section.

25 Feldman, David. (National Renewable Energy Laboratory), 2012.

Figure 3: Manufacturing vs. VC&PE Investment by Region



Source: Bloomberg New Energy Finance

CEBFP Implications

In the short term, c-Si technology is likely to remain the dominant player in the solar market, its position solidified by China's financial commitment to established c-Si firms and the currently low spot prices of silicon. This trend bodes well for CEBFP participants relying on c-Si cell technology, such as CPV firms. Conversely, CEBFP companies manufacturing panels using alternatives to silicon will be forced either to increase efficiencies or decrease costs to compete with the trends set by c-Si firms. All CEBFP companies will be forced to realize the tough competition that Chinese c-Si companies present, regardless of the solar segment in which they specialize.

CPV Technology

Concentrated PV (CPV) is a technology that uses optical components to concentrate sunlight onto PV panels to generate electricity.[26] Within the CPV market there are high, medium, and low concentration modules (HCPV, MCPV, and LCPV)—differentiated by the solar concentration of the PV cells used. While CPV is a unique technology, it still uses either silicon or thin film cells as a semiconductor for electricity.

Within the global CPV market, it is estimated that installed capacity will increase from 23 MW in 2010 to between 1,500 and 3,700 MW by 2015.[27] [28] This growth will likely be a result of CPV's

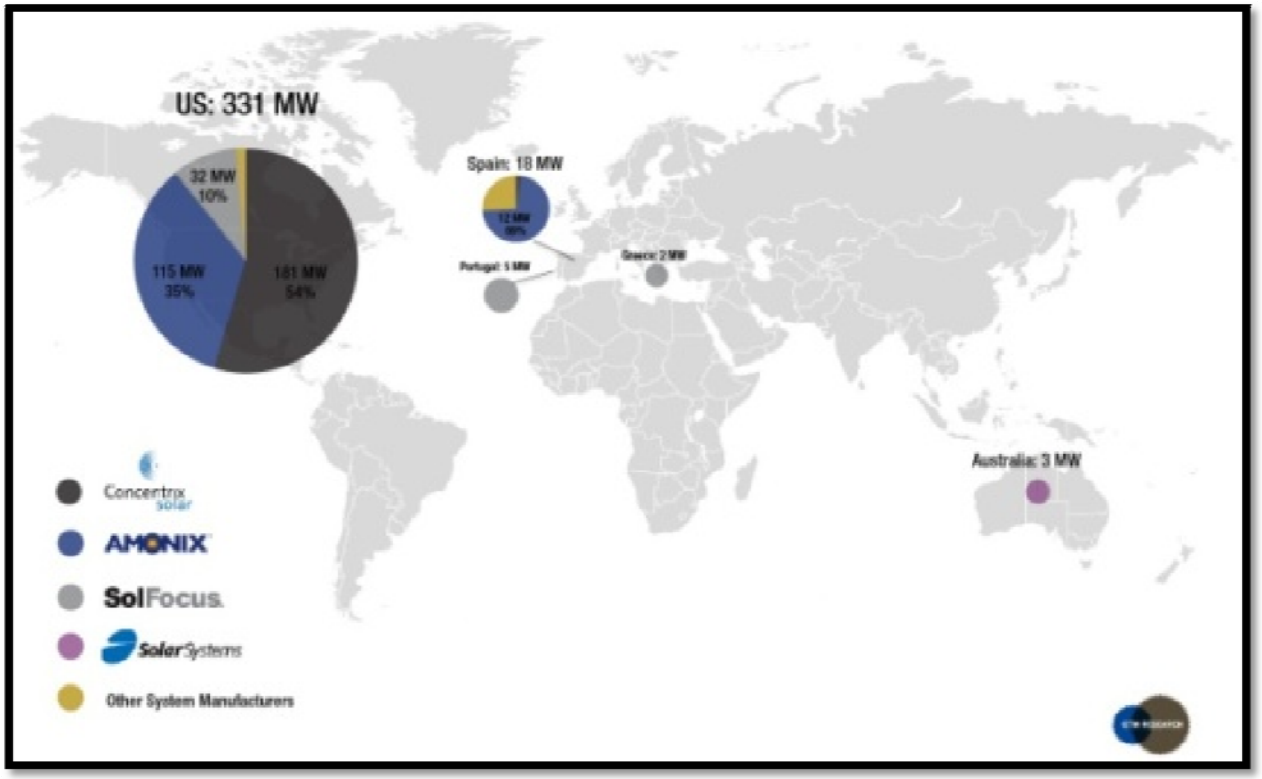
26 U.S. Department of Energy, 2010.

27 *Greentech Media*, 2011.

28 *Renewable Energy World*, 2012.

high module efficiencies, success in high direct normal irradiance (DNI)[29] areas, and the commitment by several countries to offer CPV specific incentives, such as Italy's CPV feed-in-tariff (FIT) program.[30] While Spain is responsible for 70 percent of the world's current installed capacity, the United States remains a likely leader in global CPV expansion in the near future. This is demonstrated by the number of U.S.-based projects in the pipeline, as reflected in Figure 7.[31] The majority of the projects in the United States are likely to come on-line in the Southwest, due to that area's high DNI levels.

Figure 4: CPV Projects in Operation, Construction or Development by System Manufacturer, 2011



Source: GTM Research

Despite high projected growth, CPV still faces a number of challenges. Geographically, CPV has the best competitive advantage over other PV technologies in areas where the climate is hot and dry and DNI levels are high. While parts of India, Western China, Australia, and the U.S. Southwest lend well to CPV due to high DNI levels, the technology will conversely have difficulty competing in low DNI locations.

---

29 DNI is the amount of solar radiation received per unit area by a surface perpendicular to the rays that come in a straight line from the direction of the sun at its current position in the sky. (*Glossary of Technical Renewable Energy Terminology*, 3Tier.)

30 *Renewable Energy World*, 2012.

31 *Greentech Media*, 2011.

A second crucial challenge is financing. While traditional PV still carries a volume of risk for financing institutions, CPV—which is less proven and still an emerging technology within the PV industry—has an even higher level of risk associated with it. This has resulted in high interest rates for CPV projects, which makes it difficult for CPV to compete with c-Si. In addition to the status of CPV as an emerging technology in comparison to c-Si, the drop in c-Si pricing has put competing technologies—such as CPV—in a position in which prices must decrease to stay competitive.

CEBFP Implications

For the CEBFP participants active in California, the market provides great promise due to the high DNI levels realized in Southern California. Outside California, companies that can sign contracts with countries supporting CPV through incentives will have guaranteed revenue streams as long as those countries continue to maintain their incentive structures. Furthermore, CEBFP companies that are successful at securing capital will be able to scale up fast and take advantage of a CPV market that is still growing and taking shape. Receiving the CEBFP loan will in part provide companies with greater credibility as investors realize the CEBFP loan recipients must undergo a strict underwriting and evaluation process.

Solar Supply Chain Products

This section gives a brief overview of the supply chain for a standard PV panel to provide context for the manufacturing processes performed by the CEBFP participants. While all firms have different processes for module production, many involving patented technology, this section aims to give a general overview of the process.

Given that price increases or decreases in different levels of the supply chain are crucial to a technology's viability, this section aims to show the different processes in the supply chain and to demonstrate all the levels where costs can be affected. While this section does not give an estimate of the share percentage that each supply chain process represents within a solar module's total cost, the initial cost of silicon is extremely crucial in the price of c-Si panels.

Silicon Production

The solar market supply chain starts at the raw materials supplier level, which involves silicon crystal growing and casting. At this process, blocks of multicrystalline silicon are produced from raw polycrystalline silicon and then sawed into wafers the size of compact discs (CDs). In the thin-film manufacturing process, large substrates coated with a conducting oxide layer are used in place of silicon sheets to create the wafers.[32]

Cell Production

Completed wafers are then taken to cell plants where they undergo a semiconductor processing sequence to become solar cells. This process differs for thin-film and silicon-based wafers, although both involve a process of etching, diffusion, and screen-printing to allow the wafers to conduct electricity.[33]

Module Production

At a third stage, the cells are combined onto a platform to produce a solar module. This process involves smoldering a string of cells together, then sandwiching them between a polymeric-backing sheet and a laminated glass top. In the thin-film process the cell is laminated between two pieces of glass.

Module Assembly

As a final step, the modules are fit into a solar energy system by adding inverters, batteries, wiring disconnects, and charge controllers. The assembly stage can differ based on the intended

32 SolarBuzz, 2012.

33 PV Education.Org, 2010.

end product, with assembly for concentrated solar products involving a specific design to amplify the concentration of the sun.

Solar Market Analysis

Unlike certain industries where trends are localized and geographically independent, the solar industry's supply and demand markets are tightly intertwined on a global scale. For example, market implications in China can affect manufacturing firms in California or demand markets in Germany. In analyzing the CEBFP participants, KEMA realized that looking at California level trends in the solar market would not encompass the full set of market challenges and projections facing the participants. Therefore, due to the interconnection between the demand and supply chains of the global solar market, this appendix examines trends in the International, U.S., and California solar manufacturing markets.

International Solar Market

The international solar market currently stands at $40 billion and is expected to reach $96.8 billion by 2014.[34] [35] While high levels of growth are expected, the market faces a number of challenges. Declining prices, shifting supply and demand markets, and uncertain incentives in reaction to lagging economic conditions all characterize the future status of the industry.

This section identifies a number of the key themes that have impacted the market thus far and are likely to remain trends in the near term:

- Strong European end market driven by Germany has led to large-scale growth in global demand.
- Chinese production market is growing and continues to gain manufacturing market share over other regions.
- Oversupply in the market is causing prices to drop as excess panel production balances out.
- Decreasing silicon prices are solidifying c-Si technology's status in the market and putting pressure on nonsilicon-based solar technologies.

Each of these four themes is outlined in more detail in the following sections.

Strong European End Market

With the addition of 16.6 gigawatts (GW) of capacity in 2010, global PV installed capacity is currently estimated at 40 GW.[36] As shown in Figure 8, the major demand market for PV continues to be in Western Europe, where 78 percent of 2010 PV capacity—13 GW− was installed.[37] The dominant players contributing to the increase in global capacity installed are Germany and Italy, which recorded 7.4 GW and 2.3 GW installed in 2010, representing 56

34 SolarBuzz, 2012.

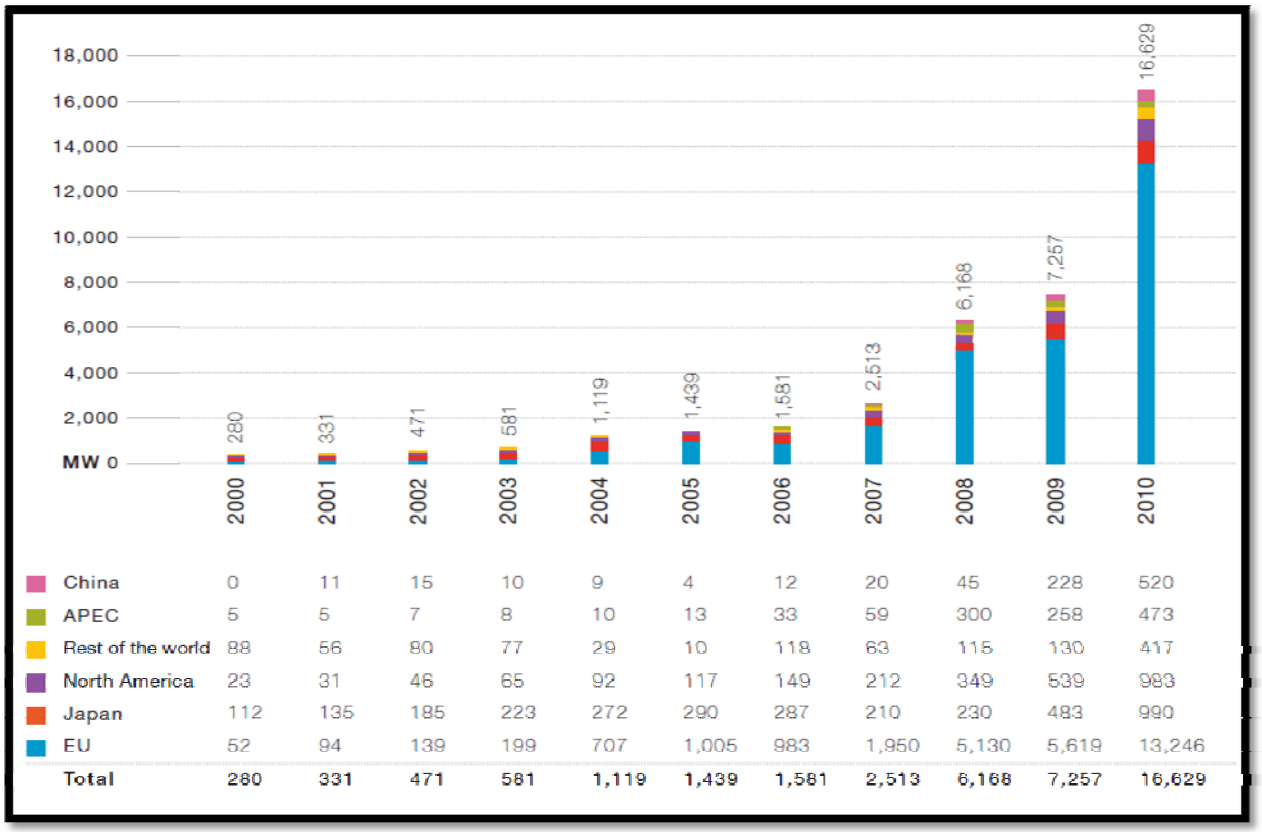
35 Reuters, 2011.

36 European Photovoltaic Industry Association, 2010.

37 SolarBuzz, 2012.

percent and 18 percent of the market.[38] Furthermore, in December 2011, Germany recorded an unexpected 1.7 GW of installed capacity as consumers anticipated a 15 percent reduction of the country's feed-in-tariff in January of 2012.[39] While Europe is expected to continue to lead the world in demand, many analysts project European solar demand to begin erode in the short term as countries scale back their solar incentive programs due to lagging economies.

Figure 5: Evolution of Global Annual PV Market, 2000-2010



Source: SolarBuzz

Chinese Manufacturing Growth

In the global PV manufacturing market Asia has become the dominant production force. Over the past several years China's growth in the solar manufacturing market has driven global prices down while exerting pressure on European and American companies. Several reasons China has maintained a growing competitive advantage in the global market place are:

- Access to large sums of capital. Both public and private investors are willing to invest large amounts of funds that are difficult for other countries to match. From mid-2010 through 2011, the China Development Bank offered $34 billion in credit lines to China's

38 *Ibid.*

39 *Greentech Media,* 2012.

solar companies, compared to the U.S. government's $1.4 billion in loans over the same time frame.[40]

- Production focused on proven technologies. Chinese companies are typically second-movers in the industry and often do not invest as much money on new technology development compared to U.S. companies. Instead, China invests in established solar manufacturing firms, which allows them to remain more risk averse.[41]
- Industry cluster effects. All of the supporting industries for solar manufacturing are located in China. Solar companies have direct geographical access to industries for paste, chemicals, machinery, wire, rare earth metals, and so forth.
- Inexpensive labor costs. Although labor contributes to less than 5 percent of the overall cost of a panel, Chinese companies save labor costs on high-level workers, such as engineers and managers.

As a result of these competitive advantages, the Chinese solar manufacturing industry has quickly increased its global manufacturing market share from 1 percent to 54 percent over the past 10 years. As shown in Figure 9, this increase has been at the expense of the U.S., Japanese, and European markets, which witnessed their combined market share decrease from 91 percent to 33 percent over the same period.[42]

40 U.S. Department of Energy, 2011b.

41 See reason stated by Quantum why it requested to withdraw from its CEBFP loan. Question: Where is this statement from Quantum documented in this report/appendix?

42 *Renewable Energy World*, 2011.

Figure 6: Regional Manufacturing Shares as a Percentage of Total, 1997-2010. [43]

Year	US	Europe	Japan	ROW	China/Taiwan	TOTAL SHIPMENTS
1997	42%	18%	25%	13%	3%	114.1
1998	38%	21%	27%	12%	3%	134.8
1999	32%	17%	39%	10%	2%	175.5
2000	30%	23%	38%	7%	2%	252.0
2000	27%	24%	41%	6%	1%	352.9
2002	21%	24%	46%	5%	3%	504.9
2003	14%	26%	52%	7%	2%	675.3
2004	13%	26%	52%	5%	4%	1049.7
2005	9%	29%	51%	5%	6%	1407.7
2006	7%	31%	44%	5%	12%	1984.6
2007	8%	32%	29%	5%	25%	3073.0
2008	7%	31%	22%	8%	32%	5491.8
2009	5%	18%	16%	14%	46%	7913.3
2010	6%	15%	12%	14%	54%	17402.3

Source: *Renewable Energy World*

Market Oversupply

The global solar manufacturing market witnessed a drastic reduction in prices in 2011 caused by an oversupply of market production.[44] Current high inventory levels are caused by a combination of slowdowns in the larger European markets—due to incentive reductions as a result of poor economic conditions—and an overadjustment by production facilities in reaction to high 2010 demand. [45], [46] The result of this oversupply is a decrease in prices. Starting in the mid-2000s, government subsidies—mainly feed-in-tariffs—in European countries created a large increase in solar demand, which caused module prices to stabilize around $4.7 per watt peak (Wp).[47] The combination of the 2007 financial crisis and an increase in manufacturing facilities to accommodate the subsidy-driven demand led to a dip in prices starting in 2008. Since 2008, manufacturing companies have been engaging in price wars while simultaneously being forced to accommodate cheap Chinese manufacturing firms.[48] These price drops are

43 *Ibid.*

44 Reuters, 2011.

45 SBI Reports, 2011.

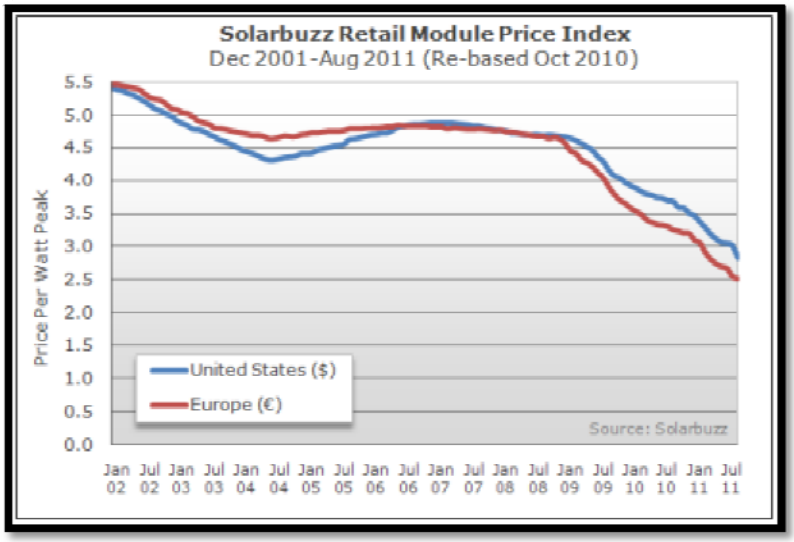
46 *Ibid.*

47 SolarBuzz, 2012b.

48 IMS Research, 2011.

reflected in Figure 7, which shows U.S. module prices decreasing 27 percent and European prices decreasing 25 percent from 2010 to mid-2011.[49]

Figure 7: Retail Module Price Index, 2002-2011



Source: SolarBuzz

Moving forward into 2012, it is expected that European and American PV markets will slow down as a lack of available government funding causes the removal of the incentives responsible for the supply glut. Ultimately, while this oversupply will thin out the pool of solar manufacturers in the short run, the resulting drop in solar prices works toward increasing solar technology's goal to reach grid parity in the long run.[50]

Decreasing Silicon Prices

An extremely influential factor affecting the panel prices of both c-Si and thin-film technologies is the price of polysilicon, the raw material used to make silicon. The price of silicon materials is significant in that it can represent up to 80 percent of c-Si module costs, having a large effect on the overall pricing of the module. In the competitive PV industry, both thin-film and c-Si companies have been jockeying for price competitive positions within the market. As thin-film technology uses alternative materials to silicon, it gains the largest price advantage when the price of polysilicon remains high. As shown in Figure 8, price trends in silicon that favored thin-film technology in the mid-2000s changed drastically in early 2008.[51] By December 2011 spot prices for polysilicon were below $30/kilogram (kg)[52], down from January 2008 numbers of $500/kg.[53] Given that thin-film technology typically has module efficiency levels of 10 to 14

---

49 SolarBuzz, 2012b.

50 European Photovoltaic Industry Association, 2010.

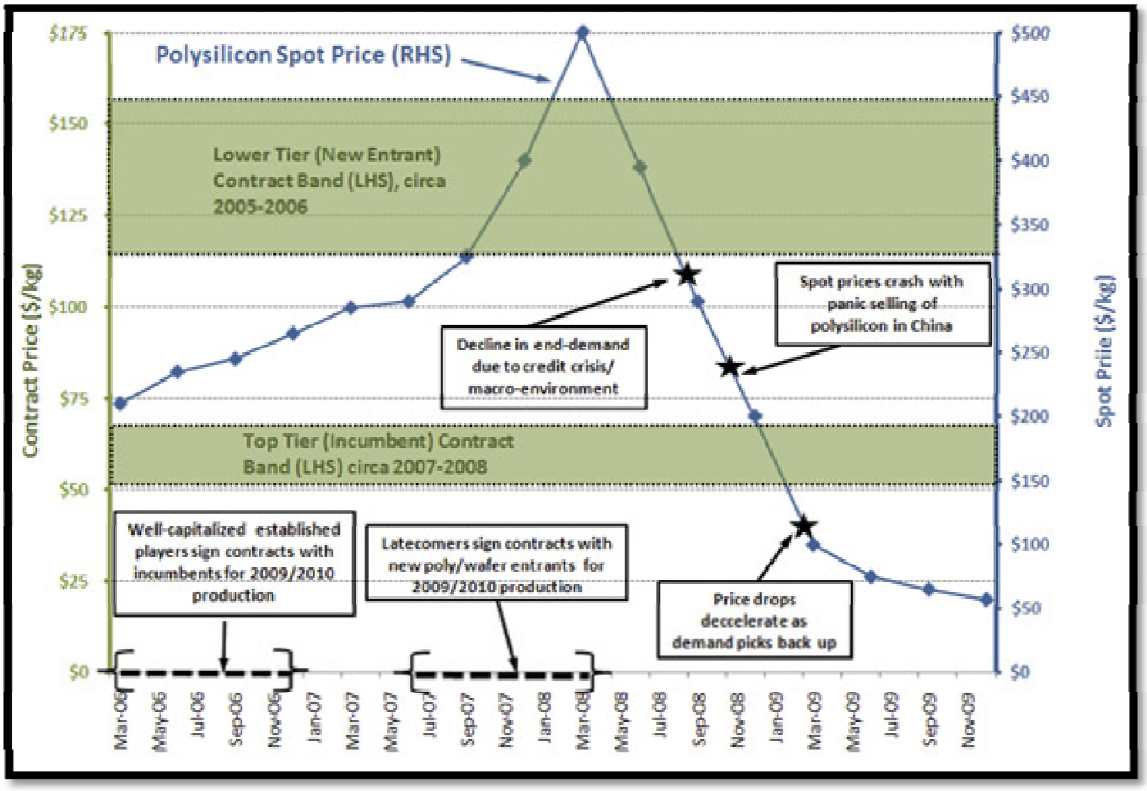
51 CBS News, 2010.

52 *Greentech Solar*, 2012.

53 California Public Utilities Commission, 2010.

percent compared to c-Si efficiency levels of 18 to 20 percent, its ability to compete in the pricing arena is severely threatened by high silicon prices.[54]

Figure 8: Chronology of Polysilicon Market Dynamics, 2006-2009



Source: CBS News

U.S. Solar Market

The U.S. solar market currently employs 100,000 people and is a $7.05 billion industry.[55] In 2010, the U.S. portion of the global manufacturing market stood around 7 percent, down from 43 percent in 1995.[56] This decline is due to shifts in demand and supply markets, which favored demand growth in Europe and production growth in China over the past two decades.[57] Despite losing global market share in supply and demand markets, the solar industry in the United States is still growing at a fast pace. In 2010, the installed capacity of the U.S. solar industry doubled, and in 2011 it was expected to increase at the same rate.[58] This section focuses on three themes in the U.S. market that are likely to continue to take form:

---

54 CBS News, 2010.

55 *Climate Change Business Journal*, 2011.

56 Solar Energy Industries Association, 2010.

57 Department of Energy, 2011.

58 Solar Energy Industries Association, 2010.

- Strong Demand Due to Certainty of Incentives
- Growing Utility-Driven Demand
- Solar Penetration Increases Outside California

Each of these three themes is outlined in more detail in the following sections.

Strong Demand Due to Certainty of Incentives

Similar to Europe, the U.S. market depends strongly upon incentives. In the United States, the federal Business Energy Investment Tax Credit (ITC) is the most influential federal incentive, which allocates a 30 percent ITC for solar energy.[59] The ITC is likely to remain a powerful tool in promoting demand certainty through its expiration in December 2016.[60] In 2009, Congress passed a bill that provided a cash grant option for commercial and industrial projects, which would provide the 30 percent equivalent in cash rather than a tax credit. While the cash grant program expired at the end of 2011, solar projects can continue to take advantage of the ITC incentive for the next five years.[61]

At a state level the Interstate Renewable Energy Council estimates that 6 of the top 10 states for PV installations rely more heavily on state or utility incentives than federal incentives.[62] Of the top 10 states in terms of PV installed capacity in 2010, 9 had a renewable portfolio standard (RPS) or financial incentive program in place. For example, New Jersey has managed to build a strong solar market due to its legislation of an RPS with a solar requirement and the creation of a Solar Renewable Energy Credit (SREC) market.[63] Even though states such as New Jersey have managed to pass strong solar incentives, ongoing economic difficulties throughout the country could hinder the renewal of solar incentives at the state and federal level.

The implication of incentives at both state and federal levels is the certainty of demand it creates in the market. With the federal ITC remaining in place through 2016, manufacturing companies can be assured the demand for solar in the United States will be relatively stable until that time.

Utility Demand Growth

As shown in Figure 12, U.S. PV demand by utilities doubled in 2010, capturing 28 percent of the market over a four-year period.[64] This increase is due to the growing number of state-adopted RPSs with solar set-asides and the cost-competitiveness of large-scale solar farms. Moving

---

59 *Ibid.*

60 US Department of Energy, Database of State Incentives for Renewables and Efficiency, 2011.

61 US Department of Energy, Database of State Incentives for Renewables and Efficiency, 2011b.

62 Interstate Renewable Energy Council, 2011.

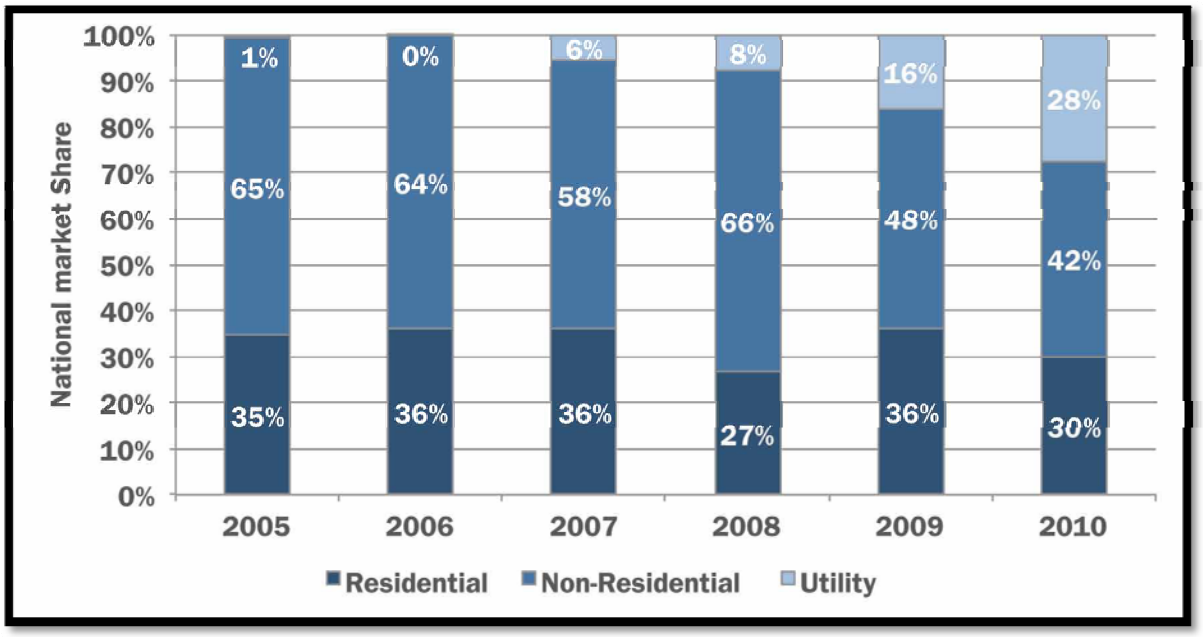
63 Interstate Renewable Energy Council, 2011.

64 Solar Energy Industries Association, 2010.

forward it is likely utilities will continue to increase their portion of the U.S. market, with some projections estimating that utilities could capture more than half of the PV market by 2015.[65]

The implications of an increase in utility demand will be a stronger certainty in demand and a larger market for utility-scale solar products. The certainty in demand is driven by the fact that utilities are secure consumers due to the RPS targets that regulate them. Given this certainty in demand, companies that are able to manufacture utility-designed products and secure hefty contracts will be able to solidify long-term supply channels. Companies that will be successful in supplying utilities with products will not be chosen by technology type, but by price. Different from early adapters and commercial applications, where niche products might be more successful, utilities will work with the manufacturing companies that have the lowest prices.

Figure 9: U.S. PV Demand by Market Segment, 2005-2010



Source: SEIA

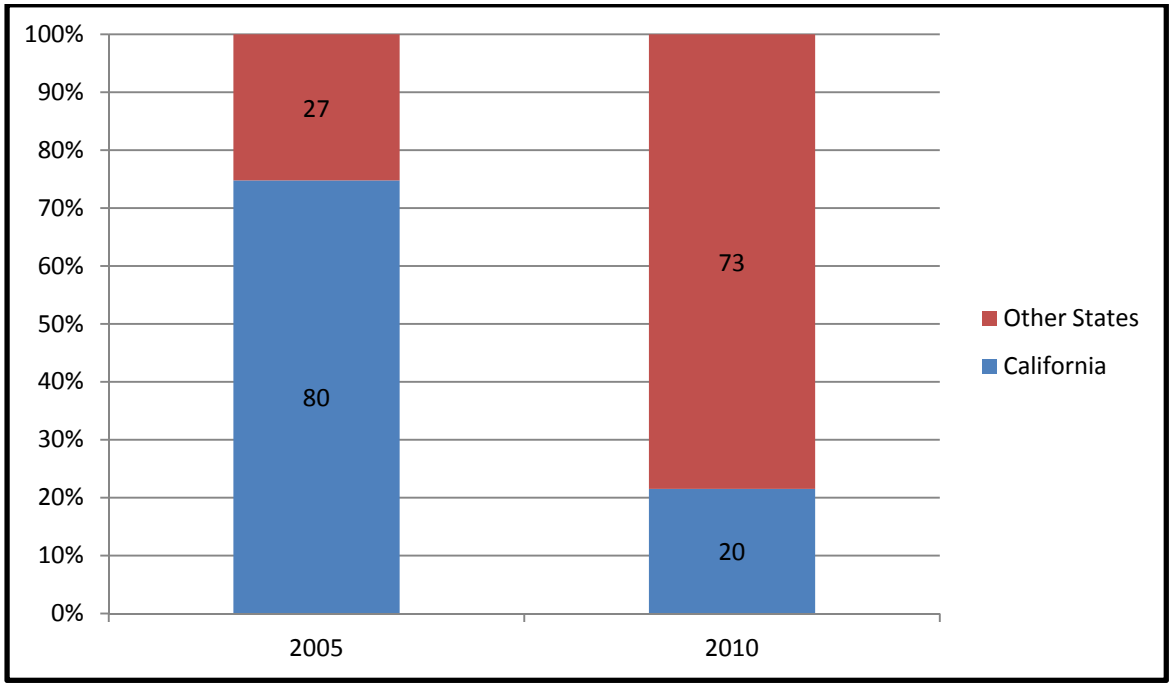
Solar Penetration Increases Outside California

The penetration of installed capacity has increased due to state-level solar incentives and RPSs. While California has typically dominated the demand market in the past, states such as New Jersey and Florida have captured more than a quarter of the market in the past several years. While California's installed capacity has continued to grow in spite of other states increasing their shares of solar energy, California's portion of the U.S. market has decreased from 80 percent to 27 percent since 2005, as shown in Figure 13.[66]

65 Solar Energy Industries Association, 2010b.

66 Interstate Renewable Energy Council, 2011.

Figure 10: U.S. Solar Electric Installed Capacity as a Percentage of the U.S. Market, 2010

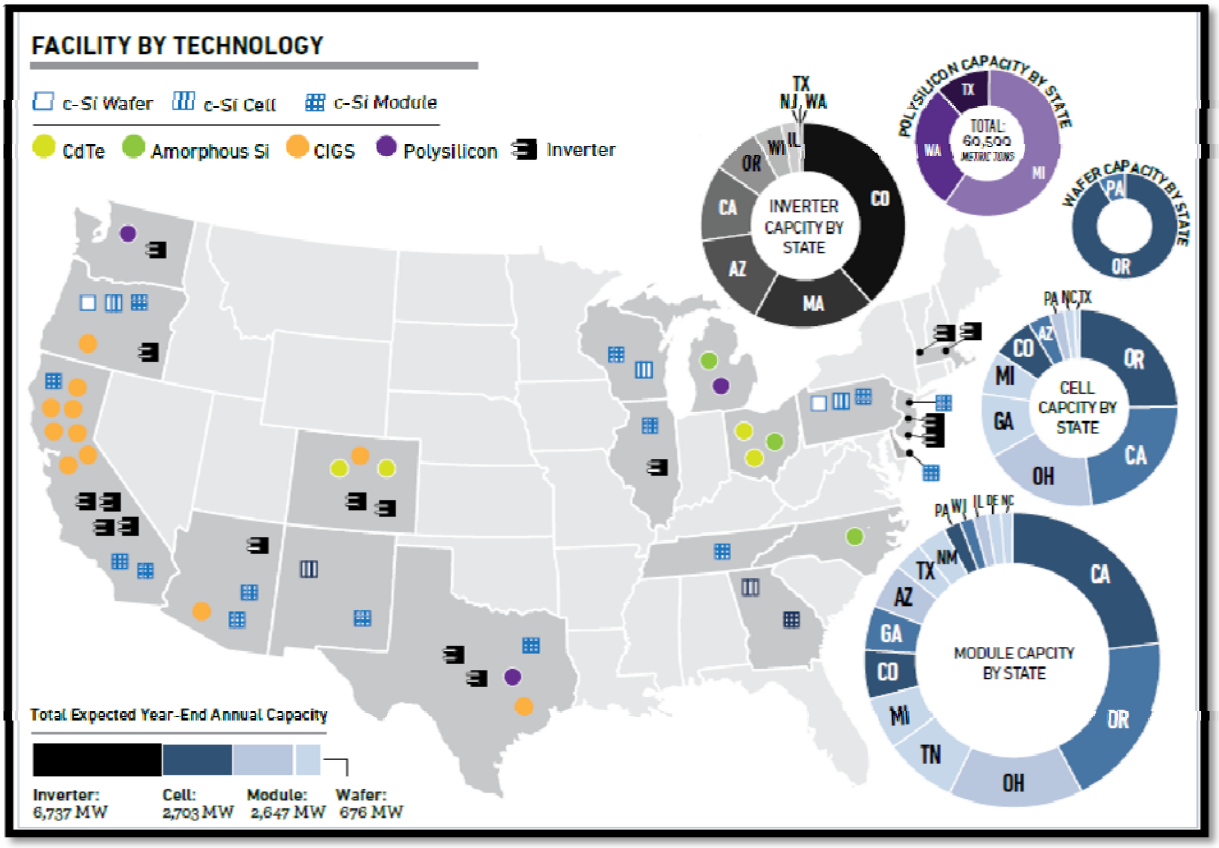


Source: Interstate Renewable Energy Council

Higher rates of solar penetration of manufacturing firms across the United States have also increased. In the past, solar production was largely focused near areas of high demand, such as California and the Northeast. More recently, the U.S. manufacturing segment of the market has begun to develop in the Midwest due, in part, to the expensive economic conditions in the traditional solar manufacturing states in the Northeast and West Coast.[67] As shown in Figure 14, both thin-film and silicon-based technologies have several manufacturing plants in the Midwest. Even though California and its surrounding states will continue to house the majority of manufacturers due to California's position as a major end market, companies are beginning to build manufacturing facilities in states that offer the most attractive incentives. Many Midwestern states, which have a history as the country's leading manufacturing hubs, are looking to draw new manufacturing companies to replace the loss in traditional manufacturers that have moved overseas.

67 Solar Energy Industries Association, 2010.

Figure 11: U.S. Manufacturing Map, 2010



Source: SEIA

California Solar Industry

At the end of 2010, California's solar industry employed 35,000 people at more than 1,100 companies.[68] A progressive set of statewide residential incentives and strict RPSs for the state's investor-owned utilities (IOUs) have created an industry that stands at 1,448 MW of installed capacity.[69] This impressive installed capacity reflects California's strong demand for solar power and its position as an attractive end market for both installers and manufacturers. At the same time, its position as an end market has produced challenges for in-state manufacturers that have watched the market become a competitive playing field for international and out-of-state companies. The sections below discuss three themes in the California market:

- Increasing demand due to solar incentives and policies
- California-based manufacturers moving facilities out of state
- California solar manufacturers facing strong competition from Chinese firms

Each of these three themes is outlined in more detail in the following sections.

---

68 Solar Energy Industries Association, 2011

69 *Ibid.*

Increasing Demand Due to Solar Incentives and Policies

California solar demand is driven by a combination of California's strict solar feed-in tariff, strong solar resources, and a solar-focused rebate program. In 2006, California passed funding for a statewide solar incentive program called the California Solar Initiative (CSI). CSI is a $3.35 billion solar rebate program projected to install 3,000 MW of new solar electricity by 2016.[70] CSI is aimed at benefitting all sectors of the market by targeting solar systems installations across nonresidential, publicly owned utilities (POU), and IOU markets. In the IOU areas, which are California's largest energy demand territories, California's three major utilities are further increasing solar demand by investing in large-scale solar projects that are cost-effective and can be used to meet the strict RPS goals set by the state. The most recent RPS targets mandate California to have 33 percent of its energy come from renewable sources by 2020. This legislation is an extension of California's Assembly Bill 32 (AB 32) that set an original benchmark of 20 percent renewable energy by 2010.[71] While the RPS regulations do not carve out a solar requirement, California's strong set of solar resources—particularly in the southern part of the state—make solar competitive with the typically cheaper wind and biomass projects. This has resulted in utility investment in large-scale solar projects that help utilities meet RPS targets while remaining cost-competitive with other technologies.[72] Finally, California passed a feed-in tariff in 2009 that requires California utilities to buy power from small solar power generators.[73] All these sets of conditions—strong solar resources, CSI rebates, a feed-in tariff, and RPS regulations—will have the effect of continuing to bolster a strong demand market in a state that is already recognized as a large solar end market.[74]

California-Based Manufacturers Moving Facilities out of State

California has seen a large number of its homegrown solar companies move manufacturing facilities to other states and countries in the past several years. Most of the companies are moving their offices or constructing new manufacturing facilities outside California to take advantage of other states' tax incentives, cheaper labor, and more favorable regulatory environments.[75] For example, in 2010 the state of Wisconsin offered California-based W Solar Group $28 million in Enterprise Zone tax credits to move its operations from California to

---

70 Go Solar California, 2011

71 California Energy Commission, 2011

72 In states without strong solar resources, RPS regulations are less successful in promoting solar projects due to their higher cost. As a result, many states have carved out set-asides (requirements) for solar within their RPS targets. California has not carved out solar set-asides and has still seen a successful level of growth in solar energy, which is largely attributed to the profitability of large scale solar projects in areas where solar resources are strong.

73 *MarketWatch*, 2009

74 Discussed in California Solar Industry section

75 For example, CEBFP participants Stion Corp and SoloPower are both building new manufacturing plants in other states (MS and OR), despite their headquarters being located in California.

Wisconsin. The company moved its headquarters within a year and is expected to create a total of 620 jobs in Wisconsin.[76] Of the different incentive packages offered by states, incentives focused on immediate funding—such as property tax exemptions and unrestrictive low-interest loans—have been the most successful at drawing companies outside California.

California Solar Manufacturers Face Strong Competition From Chinese Firms

One of the main challenges for California solar firms is the rise of Chinese solar manufacturing companies.[77] As shown in Figure 15, Chinese manufacturers accounted for 42 percent of the California market in 2010, up from 2 percent in 2008.[78, 79] The entrance of Chinese products in California is largely a reaction to California's new solar policies that have bolstered a large market demand. In the near term, U.S.-based manufacturers will have to improve technology efficiencies to compete with Chinese firms' low cost and economies of scale. In the long run, while the addition of cheap Chinese panels will drive out American firms that cannot provide competitively priced modules, consumers will ultimately benefit from lower overall prices.

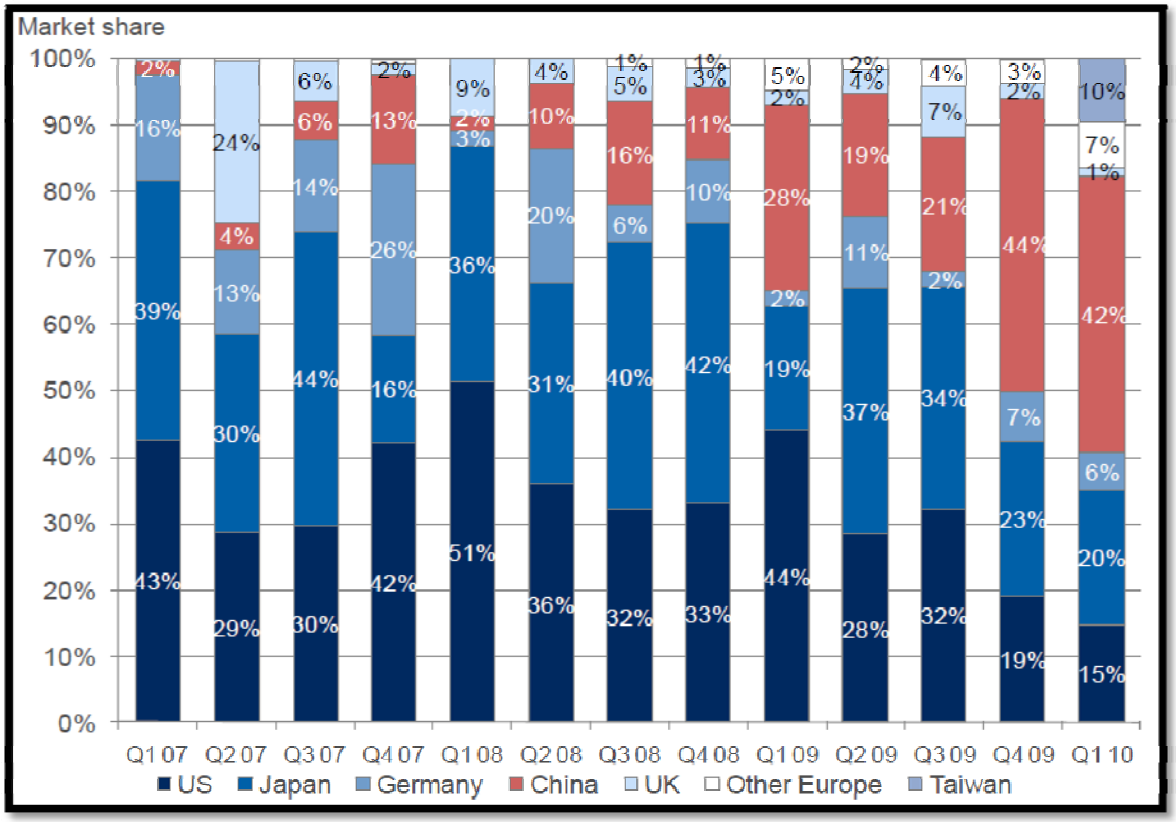
76 Wisconsin Department of Commerce, 2010

77 Many of the contributing factors to the Chinese rise in the California market share are dependent on Chinese policies and global trends, which are discussed in Section A.5.3.

78 Based on analysis conducted from Energy Commission website on production projects by company

79 Bloomberg New Energy Finance, 2010

Figure 12: CSI Module Suppliers by Country, Q1 2007- Q1 2010



Source: CSI, Bloomberg New Energy Finance

Conclusion

The ultimate success of the CEBFP will depend on the performance of the solar manufacturers that were awarded loans. If the CEBFP funding is used to improve product assembly processes and drive down production costs, then jobs will be created, and California will have a stronger and more viable clean energy manufacturing base. In addition, the loans will be repaid and provide a sustainable pool of funds for future reinvestment.

Given all the factors presented in this report, the clean energy industry faces many challenges over the next few years. Funding sources such as the CEBFP can help stabilize this emerging industry. The key to success will be a thorough understanding of the risks involved at the individual company and broader market levels. Addressing the recommendations put forth in the program evaluation section of this report should be considered a first step in addressing and lowering these risks.

Bibliography

European Photovoltaic Industry Association, 2010. ***Global market outlook for Photovoltaics until 2014***. May, 2010.

Feldman, David. (National Renewable Energy Laboratory), 2012. **Article referencing Bloomberg New energy finance data. January 2012.**

U.S. Department of Energy, 2009. ***The History of Solar***, 2009.

Greentech Solar, 2011. PV News Annual Data Collection Results: 2010 Cell, Module Production Explodes Past 20 GW, May 2011.

MarketResearch.com, 2012. ***Thin-Film PV - Global Market Size, Price Analysis, Regulations and Competitive Landscape to 2020***, January, 2012.

U.S. Department of Energy, 2010. Glossary, June, 2010.

Greentech Media, 2011. ***Concentrating Photovoltaics 2011: Technology, Costs and Markets***, May, 2011.

Renewable Energy World, 2012. Global Concentrated Photovoltaic Market Growth and Investments, February, 2012.

Greentech Solar, 2011b. ***GTM Research Issues the CPV State of the Union***, May, 2011.

SolarBuzz, 2012. Manufacturing, 2012.

PV Education.Org, 2010. Screen-printed Solar Cells, 2010.

Solar Energy Industries Association, 2011. ***CALSEIA and National SEIA Formalize Partnership to Grow California Solar Market***, September, 2011.

Go Solar California, 2011. About the California Solar Initiative (CSI), March, 2011.

California Energy Commission, 2011. ***California Renewable Energy Overview and Programs***, April, 2011.

Wisconsin Department of Commerce, 2010. Governor Doyle Announces W Solar Group Will Relocate to Wisconsin, December, 2010.

Bloomberg New Energy Finance, 2010. Joined at the hip: the US-China clean energy relationship, October, 2010.

Climate Change Business Journal, 2011. ***U.S. Solar Market Grows To $7.05 Billion, Including Environmental Consulting & Engineering Services***, July, 2011.

Solar Energy Industries Association, 2010. ***US Solar Market Insight 2010 Year in Review***, 2010.

Department of Energy, 2011. ***Department of Energy to Invest $50 Million to Advance Domestic Solar Manufacturing Market***, Achieve SunShot Goal, August, 2011.

US Department of Energy, Database of State Incentives for Renewables and Efficiency, 2011. ***Business Energy Investment Tax Credit***, November, 2011.

US Department of Energy, Database of State Incentives for Renewables and Efficiency, 2011b. ***Renewable Energy Grants***, November, 2011.

Interstate Renewable Energy Council, 2011. ***US Solar Market Trends 2010***, June, 2011.

Solar Energy Industries Association, 2010b. ***Commercial Sector Drives U.S. Solar Market with 38 Percent Growth in Third Quarter***, Solar Costs Continue Decline According to Latest U.S. Solar Market Insight Report, December, 2010.

SolarBuzz, 2012. ***Global Market Size***, 2012.

Reuters, 2011. ***Samsung SDI sees $70 billion global solar cell market by 2020***, September, 2011.

GreenTech Media, 2012. ***Germany Installed More Than 2 GW of Solar in December***, January, 2012.

US Department of energy, 2011b. Steven Chu: ***My Testimony to the House Energy and Commerce Committee***, November, 2011.

Renewable Energy World, 2011. Reality Check: ***The Changing World of PV Manufacturing***, October, 2011.

Reuters, 2011. Price declines, oversupply to hit solar Q3, October, 2011.

SBI Reports, 2011. ***Thin Film Solar PV Manufacturing Equipment Worldwide***, July, 2011.

SolarBuzz, 2012b. Module Pricing, 2012.

IMS Research, 2011. PV Cells & Modules - Supply & Demand Quarterly – Q3'11, September, 2011.

CBS News, 2010. Lesson from Vestas to First Solar: Stay Out of China, September, 2010.

Greentech Solar, 2012. Polysilicon Prices Hit Record Low in 2011; Will Head Even Lower, Enabling $0.70/W PV in 2012, January, 2012.

California Public Utilities Commission, 2010. ***California's Solar PV Paradox: Declining California Solar Initiative Prices and Rising Investor Owned Utility Bid Prices***, October, 2010.

SolarBuzz, 2012. Module Pricing Trends, February, 2012.

MarketWatch, 2009. Sweet, Cassandra. California's solar-power feed-in tariff becomes law. October, 2009.

APPENDIX C
Interview Guides

Financial Development Corporation Interview Guide

Purpose of Interview

The purpose of this interview is to help KEMA/CEC understand how underwriters/loan servicers in the CEBFP developed, launched, implement, and monitor revolving loan fund programs targeting the program participants. The emphasis is on lessons learned for more effective and efficient administration of future programs.

Contact name/title: _____
Email/Phone: _____
lender/Office: _____
Interviewer: _____

Questions

Revolving Loan Fund Program

1. What is the purpose of the program?
2. Why did you choose to participate in the CEBFP?
3. Did you do any marketing for the CEBFP?

Application of Funds

4. How many applications did you receive?
5. Do you monitor how the funds are used?
    - If yes: Please specify how monitoring occurs and how often.
    - Do you receive project status reports from loan awardees?
        - If yes: Are there any red flags for any of the participants?
6. Are you seeing any changes in the companies as a result of the funding? (balance sheets, growth, other?)

Funding challenges

7. Based on your analysis, what would have happened to the projects you underwrote/serviced in the absence of CEBFP funding?
    - How do these loans compare to other loans you have underwritten in terms of risk?
    - Debt to Worth ratio
    - Debt Coverage Ratio (DCR)
    - Cash Flow
        - Current Ratio (liquidity)
        - Quick Ratio
    - Company Character
8. What are your expectations for repayment? Do you expect the loans to be paid
    - Early?
    - On time?
    - Late?
        - If Late, by how long and why?
    - Default?

Industry/ Market Impacts

9. What are some market challenges that might affect the program and future funding needs?
10. Were there any market conditions identified during the underwriting process that favored particular industries (i.e. solar companies)?
    - If yes: Please describe.
11. What market segments do you see as having the most need for financing?

Recommendations

12. Which parts of the program worked the best for your institution?
    - Why?
13. Which parts of the program did not work well for your institution?
    - Why?
14. How would you change the program to improve its effectiveness?
15. Based on your perspective, what are the prospects for the fund to be self sustaining?

CEBF Awardee Firm Interview Guide

Purpose of Interview

The purpose of this interview is to help KEMA/ CEC understand how participants learned about the CEBF program and how it affected their business operations, employment, revenue, and competitiveness.

Contact name/title: _____
Email/Phone: _____
Company: _____
City/Zip: _____

Questions

CEBF Program

1. What are your typical sources of funding?

- Venture Capital
- Bank loans
- Federal / State agency funding
- Grants
- Other equity or loans

2. How did you learn about the CEBF Program?
3. What influenced your decision to participate/not participate in the program?

- Needed funding from somewhere
- Needed matching funds for VC dollars
- Interest rate was attractive
- Overall terms were attractive

4. Did you consider other funding options (Federal/State/Private)?

- How did those funding options compare to CEBF?

5. What states offered the most attractive funding environments?

Application of Funds

6. Were your funds used as you had projected in your CEBF application?

- If yes: Please specify how the funds were used (employment, investment, etc).
- If no: How did your funding projections differ from your actual application of the funding?

7. Were the CEBF funds combined with any additional government loan funds for your project?
8. What changes to your business (real or anticipated) are a result of CEBFP funding? Please Specify for:

- Units sold

- Production volume
- Product lines
- Efficiency of operation
- Staff numbers
- VC investment/interest *(for startups)*
- Additional government funding (did it make them more favorable for other loans?)

Funding challenges

9. Did you have any challenges in getting access to capital outside the program?

- If yes: please describe.

10. How did you hear about the CEBF Program?
11. Did CEBF funding allow you to be more competitive in securing additional capital?
12. What would have happened to your project in the absence of CEBF funding?
13. Once you were awarded funding, did you ever consider withdrawing from the program? If so, what factors influenced this decision? (as four companies got awards then withdrew)
14. What are your company's expectations for repayment?

- Do you plan to pay off the loan early? On time? Late?
- If Late, by how long and why?

Impact on employment

15. How many and what types of manufacturing jobs (FT or PT) were created as a result of the CEBF funding?

- Part-time
- Hours per week
- Full time
- Hours per week
- Manufacturing (skilled)
- Manufacturing (unskilled)
- Administrative

16. What are the typical wages for the jobs created/ retained?

- Dollars/hour
- Benefits

17. Have any jobs been lost since the time you were awarded the funding?

- If yes: why?

Industry/ Market Impacts

18. What are some industry innovations / new technology that your company expects to see within the next 5 years?

- Will these innovations negatively or positively affect your company's operations?

19. What are some market challenges that might affect your operations and future funding needs?

- What other states/countries have you explored for past/future investment?
- Why?

20. What companies present the largest competition to your projects?
21. Do programs such as CEBF increase your competitiveness with these companies?

- If positively affects business then…
- How?

CEBF Recommendations

22. Which parts of the program worked the best for your company?

- Why?

23. Which parts of the program did not work well for your company?

- Why?

24. If you could improve the program what would you change?
25. Would you participate again given the opportunity?

- If no: What parts of the program would need to change to for you to participate?

State Energy Office Interview Guide

Purpose of Interview

The purpose of this interview is to help KEMA/CEC understand how state energy offices developed, launched, implement, and monitor revolving loan fund programs targeting the industrial sector. The emphasis is on lessons learned for more effective and efficient administration of future programs.

Contact name/title: _____
Email/Phone: _____
State/Office: _____
Interviewer: _____

Questions

Revolving Loan Fund Program

1. What is the purpose of the program?
2. What was the amount your initial loan pool?
   - All ARRA dollars?
3. Do you administer the program in-house?
4. Are there multiple lenders?
5. What are the terms of the loans?
   - Rate and Duration
6. Were matching funds required?
7. How did you market the finance program?
   - Program Name
   - Outreach activities
     - budget
   - Advertising activities
     - budget
8. Why did you choose a loan fund over other funding options such as grants or rebates?
9. What type and frequency of reporting is required?

Application of Funds

10. How many applicants?
11. How many awards?
12. Posted on websites?
13. Were your funds used as you expected?
    - If yes: Please specify how the funds were used (employment, investment, etc).
    - If no: How did your funding projections differ from your actual application of the funding?
14. Are you seeing any changes in the companies as a result of the funding?
    - Please Specify:
      - Units sold
      - Production volume

- Product lines
- Efficiency of operation
- Staff numbers
- Additional government funding (did it make them more favorable for other loans?)

Funding challenges

15. What would have happened to your projects in the absence of ARRA funding?
16. Once you awarded funding, did you ever consider withdrawing it from the recipient? If so, what factors influenced this decision?
17. What are your expectations for repayment? Do you expect the loans to be paid
    - Early?
    - On time?
    - Late?
      - If Late, by how long and why?
    - Default?

Impact on employment

18. How are jobs defined?
19. How do you determine the number of jobs retained/created? (Did you count jobs or use a calculation?)
20. Is any jobs analysis being performed?
21. What types of jobs were created as a result of the program?
    - Engineer
    - Manager
    - Executive level
    - Manufacturing (skilled)
    - Manufacturing (unskilled)
    - Administrative
    - _____
    - _____
22. For each of these job types what are the projected duration (years) for each position?
23. What are the typical wages for the direct jobs created/ retained?
    - Dollars/hour
    - Benefits
24. What was the level of experience (in job years) of the new hires?
25. What industries did your new hires come from?
    - If solar industry: How long have they been in the industry?
    - If not solar industry: What skills were transferrable to solar industry?
26. Did any of your new hires have to relocate for the position?
    - If yes: From where?
27. Have any direct jobs been lost since the time you awarded the funding?
    - If yes: why?

Industry/ Market Impacts

28. What are some market challenges that might affect the program and future funding needs?
29. Were there challenges with retaining/creating jobs within the state?

Recommendations

30. Which parts of the program worked the best for your state?
    - Why?
31. Which parts of the program did not work well for your state?
    - Why?
32. How would you change the program to improve its effectiveness?
33. What are the prospects for the fund to be self sustaining?